Long Beach Water Department and Water Replenishment District of Southern California

Final Report

Recycled Water Master Plan

November 2010

MWH

BUILDING A BETTER WORLD

Recycled Water Master Plan

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Prepared for:
Long Beach Water Department and
Water Replenishment District of Southern California

Prepared by:
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MWH

BUILDING A BETTER WORLD

November 22, 2010

Mr. Eric Leung, PE
Director of Water Resources
Long Beach Water Department
1800 E. Wardlow Road
Long Beach, CA 90807

Subject: Final Recycled Water Master Plan

Dear Mr. Leung:

MWH is pleased to submit the final report on the Recycled Water Master Plan for the Long Beach Department of Water and Power (LBWD). This report is submitted in accordance with the terms of our agreement dated January 4, 2010.

The Recycled Water Master Plan contains an executive summary that presents the findings and recommendations regarding LBWD's recycled water system. The plan presents the anticipated increase in LBWD's recycled water use as well as an evaluation of future recycled water requirements for the Water Replenishment District's (WRD) Leo VanderLans Treatment Facility. Potential customers are identified and pipeline alternatives are developed to connect them to the recycled water system. An economic analysis prioritizing the potential pipeline alternatives is also presented in the report. A detailed evaluation of storage requirements under different future demand conditions is presented. Operational and infrastructure recommendations necessary to meet future growth are identified along with their estimated costs for implementation. A Capital Improvement Program (CIP) that only considers those future customers that will be served recycled water in the near-term is also presented.

We wish to express our appreciation to you, the LBWD staff, and the WRD staff for their assistance and input during this planning effort. We look forward to assisting you in the future with the implementation of this plan.

Sincerely,

MWH Americas, Inc.

Matthew Huang, P.E.
Project Manager

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Table of Contents

LIST OF TABLES

Table **Page Number**

LIST OF FIGURES

Figure **Page Number**

APPENDICES

Executive Summary

The Recycled Water Master Plan (RWMP) is jointly funded by the LBWD and the Water Replenishment District of Southern California (WRD). LBWD has been providing recycled water from LACSD's Long Beach Water Reclamation Plant (LBWRP) since the 1980s to customers in its service area, and was among the first to do so in Southern California. The intent of this study is to develop a RWMP for LBWD's service area that will assist LBWD staff to identify potential recycled water customers and the required recycled water infrastructure to meet future demands.

WRD uses recycled water supplied by LBWD at its Leo VanderLans (LVL) treatment facility for the purposes of sea-water barrier injection (Alamitos Barrier). A proposed expansion of the LVL treatment facility is currently being planned. The intent of this expansion is to replace the imported water used for the sea-water barrier injection with recycled water. It is expected that the expanded facility will have a treatment capacity of approximately 7.6 million gallons per day (mgd) which is approximately two times the current treatment capacity of 3.8 mgd. The study will determine the amount of recycled water that is available to WRD's LVL facility under different demand and storage conditions in the future.

EXISTING RECYCLED WATER SYSTEM

From serving just one City park in the 1980s, the recycled water customer base and distribution have grown to include other public and private irrigation customers, such as parks, schools, golf courses, cemeteries, and garden nurseries, as well as the repressurization of offshore oil bearing strata. The LBWD has approximately 90 recycled water service connections with a maximum month demand of seven mgd. The two largest customers are LVL and THUMS with average demands of two mgd and one mgd respectively. LBWD's recycled water system consists of:

- Two Pressure Zones
- Approximately 26 miles of pipeline ranging from 6 to 36-inches in diameter
- Three above-ground 3.3 million gallon (MG) steel storage tanks located at the Alamitos Reservoir Hill Storage Facility
- Three booster pump stations: El Dorado and THUMS pump stations, both located at LBWRP, and another booster pump station at South Lake in the Lakewood Country Club Golf Course
- One backup booster pump station which supplies groundwater via El Dorado Lake as a backup supply to the recycled water system during emergency
- One groundwater well; El Dorado park well, which supplies untreated groundwater for El Dorado Park Lake makeup following pumping of water from the lake by the emergency backup pump station
- Control valves and other appurtenances

LBWD's primary recycled water supply is met by the effluent from the LBWRP, which is owned and operated by Sanitation Districts of Los Angeles County (LACSD). The recycled water is pumped from the chlorine contact basin at the LBWRP by the El Dorado/THUMS Pump Station.

PROJECT APPROACH

Available recycled water supplies to accommodate the expansion of the recycled water system are determined by performing an existing supply-demand balance Potential recycled water customers are identified based on available consumption data (monthly billing records) from LBWD's largest fifty (50) potable water customers, all potable irrigation customers, and customers that were identified in the 2003 RWMP. Alternative pipeline projects are developed to connect most of the potential recycled water customers to the recycled water system. An economic cost analysis is prepared to determine the prioritization of the proposed projects.

A hydraulic model is created using LBWD's Geographic Information System (GIS) as the basis. The model includes all facilities within LBWD's recycled water system. Calibration of the model is performed based on flow data gathered during the week between Friday, August 7th through Thursday, August 13th, 2009. Nine sites throughout the distribution system are chosen for flow or pressure comparisons. The hydraulic model is used to evaluate LBWD's recycled water system for existing and future demand conditions and points of low pressures, high velocities, storage reservoir levels, and pump station operations are investigated. Storage reservoir required to meet future demands are identified

Following the existing and future system evaluation, operational and infrastructure improvements along with the associated capital costs are presented.

POTENTIAL RECYCLED WATER CUSTOMERS

Potential recycled water customers are identified based on available consumption data (monthly billing records) from LBWD's largest fifty (50) potable water customers, all potable irrigation customers, and customers that were identified in the 2003 Recycled Water Master Plan (RWMP). Only existing potable water customers having a demand greater than 20 acre-feet/year (acre-ft/yr) are considered as potential recycled water customers. Potential customers are identified by recycled water usage category, prioritized by average annual recycled water usage, and categorized by the likelihood of conversion from potable to recycled water. The potential recycled water demand in LBWD's service area can be categorized into two categories: 1) expansion of existing recycled water customers and 2) conversion of customers from potable to recycled water.

Expansion of Existing Recycled Water Customers

WRD has received Federal Stimulus Funding to complete a preliminary design for the expansion of the LVL. Currently, the water injected in the wells is a blend of 50-percent recycled water and 50-percent imported water. WRD is interested in injecting its barriers solely with recycled water, thereby increasing its recycled water demand from 3.8 mgd to 7.6 MGD, equating to a total demand of approximately 8,740 acre-ft/yr with a demand increase of 4,370 acre-ft/yr.

THUMS Long Beach Company (THUMS) is currently LBWD's largest existing recycled water customer and uses recycled water for groundwater injection to re-pressurize offshore oil-bearing strata. THUMS will not be expanding its facilities, however, it is possible that THUMS may increase its recycled water demand in the future by replacing the potable water currently

purchased from the Port of Long Beach (POLB). The site for an additional connection to THUMS is located at POLB's Pier J.

Conversion of Customers from Potable to Recycled Water

Forty-nine (49) LBWD and POLB customers have been identified as potential recycled water customers using more than 20 acre-ft/yr. These customers would be converted from potable to recycled water supplies. These customers include schools, golf courses, parks, power plants, oil refineries, hospitals, hotels, nurseries, commercial laundries and other industrial and residential customers, as summarized in **Table ES-1**.

Table ES-1
Summary of Potential Recycled Water Usage in Acre-Feet/Year
(By Customer Type)

Customer Type	Sum of Estimated RW Demand (acre-ft/yr)
Commercial Laundry	126
Golf	62
Hospital	152
Hotel	40
Industrial	797
Nursery	133
Oil	657
Park	185
Power	1,817
Residential	230
School	309
Total	**4,510***

Note: Estimated Recycled Water Demand is determined by the average water consumption from LBWD billing data multiplied by an assumed recycled water percent usage (see **Section 5** for details).
*Total recycled water demand rounded to the nearest ten.

Other Potential Recycled Water Demands

The City of Signal Hill is interested in receiving recycled water from LBWD to serve customers within their service area. The City of Signal Hill has estimated their recycled water demand to be approximately 404 acre-ft/yr (see **Appendix D** for details**)**. By serving the City of Signal Hill, LBWD would also be able to deliver recycled water to LBWD customers located further away from the existing recycled system that may not be feasible to reach without having to cross the City of Signal Hill. These additional customers would be Chittick Field Park, Long Beach City College, Martin Luther King Jr. Park, and the proposed park in California Bowl.

The City of Lakewood has an existing recycled water system and is interested in serving additional customers with recycled water. The estimated additional recycled water demand of 150 acre-ft/yr (see **Appendix E** for details**)**. Customers with a recycled water demand greater or equal to 20 acre-ft/year include Bolivar Park, Lakewood Elementary, and Hoover Junior High School (shown on **Figure 6-2)**.

Other neighboring cities that may be interested in receiving recycled water from LBWD include the Cities of Seal Beach and Paramount. The potential recycled water demand for these cities needs to be further investigated.

ALTERNATIVE DEVELOPMENT AND EVALUATION

Alternative pipeline projects have been developed to connect most of the potential recycled water customers to the recycled water system. The routing of the proposed projects are considered using a number of factors. In general, the each alternative seeks to maximize the connections to significantly large-volume potential customers and terminate at the site of a major customer, generally a user with a minimum recycled water demand of 50 acre-ft/yr. Other factors considered for pipeline routing include ease of construction due to vehicle traffic, road conditions, crossing of freeways, railroad tracks, and flood control channels, as well as other factors.

Eleven (11) pipeline projects serving a variety of recycled water customers are developed and listed in **Table ES-2**. These projects include alternative pipeline segments that are connected to existing recycled water pipelines (See **Figure 6-3** in **Section 6**). Each project is separated by industrial or irrigation recycled water usage. Several projects (i.e., Project No. 1, 7, 9, and 11) provide multiple pipeline routings to serve select large industrial customers. Several customers such as the Marina Pacific Housing Association, Parwood Apartments and Long Beach Polytechnic High School are located at such a long distance from an existing recycled water pipeline that it is currently not feasible to serve these customers. Medico Professional Linen is a potential customer with an estimated recycled water demand of 23.2 acre-ft/year, and is located on an existing LBWD recycled water pipeline alignment where a direct connection can be made to the recycled water system.

An economic cost analysis is prepared to determine the prioritization of the proposed projects. The payback period is used to prioritize the projects, which is determined by the total potential demand along the proposed pipeline alignment divided by the potential gains from those customers. The prioritization of the projects are presented in **Table ES-3**. Project No. 8 is most feasible with a total recycled water demand 102 acre-feet/yr, total capital cost of $240,000, and is estimated to take 13 years to pay off the capital costs from the revenue received from the customers. Project No. 9A by itself is the least feasible with a payback period of 386 years. However, if projects 9A, 9B, 9C, and 9D are treated as a single project, then the payback period reduces to 55 years thereby increasing its feasibility.

Projects that are more likely to occur in the near-term are presented in **Table ES-4**. These projects are recommended pipeline alternatives that will serve the “most probable” customers or the customers that have the highest potential of converting to recycled water in the near term.

Table ES-2
Potential Recycled Water Customers by Proposed Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
Project No. 1												
1A	11	L A County Community Develop	L A County Community Development	Yes	Residential	Irrigation	801 Via Carmelitos	52.3	32.5	7.4	239.5	Largest 50 Potable Customers
							Project 1A Total	52.3	32.5		239.5	
1B	14	Paradise Gardens LP	Paradise Gardens LP	No	Nursery	Irrigation	6479 Atlantic Ave	43.8	27.2	7.4	200.4	Largest 50 Potable Customers
1B	30	L B Parks Bureau	De Forest Park	No	Park	Irrigation	6175 De Forest Ave	25.4	15.7	7.4	116.2	All Potable Irrigation Customers
1B	35	L B Parks Bureau	Houghton Park	No	Park	Irrigation	6330 Atlantic Ave	23.2	14.4	7.4	106.2	All Potable Irrigation Customers
1B	26	Long Beach Villa Park, LLC	Long Beach Villa Park LLC	No	Residential	Irrigation	6475 Atlantic Ave	27.4	17.0	7.4	125.3	Largest 50 Potable Customers
							Project 1B Total	119.8	74.3		548.2	
1C	44	Kohara, Ken	Kohara, Ken	No	Nursery	Irrigation	1065 Inez St	20.5	12.7	7.4	93.8	All Potable Irrigation Customers
1C	33	L B Unified School District	Hamilton Middle School	No	School	Irrigation	1060 E 70th St	23.4	14.5	7.4	106.9	All Potable Irrigation Customers
							Project 1C Total	43.9	27.2		200.6	
							Project No. 1 Total	216.0	133.9		988.3	
Project No. 2												
2	43	L B Unified School District	Hubert How e Bancroft Junior High School	No	School	Irrigation	5301 Centralia St	21.4	13.3	7.4	98.0	All Potable Irrigation Customers
							Project No. 2 Total	21.4	13.3		98.0	
Project No. 3												
3	21	L B Unified School District	John Marshall Middle School	No	School	Irrigation	5870 E Wardlow Rd	32.3	20.0	7.4	147.6	All Potable Irrigation Customers
							Project No. 3 Total	32.3	20.0		147.6	
Project No. 4												
4	16	L B Unified School District	Milliken High School	Yes	School	Irrigation	2800 Snow den Ave	39.3	24.4	7.4	180.0	All Potable Irrigation Customers
							Project No. 4 Total	39.3	24.4		180.0	
Project No. 5												
5	31	L B Unified School District	Stanford Middle School	No	School	Irrigation	5871 Los Arcos St	24.2	15.0	7.4	110.7	All Potable Irrigation Customers
							Project No. 5 Total	24.2	15.0		110.7	
Project No. 6												
6	49	Long Beach Airport Marriott	Long Beach Airport Marriott	Yes	Hotel	Irrigation	4700 Airport Plaza Dr	19.5	12.1	7.4	89.2	Largest 50 Potable Customers
							Project No. 6 Total	19.5	12.1		89.2	
Project No. 7												
7A[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
							Project 7A Total	1000.0	620.0		2479.8	
7B[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
7B	5	AES Southland LLC,	AES Southland LLC	No	Pow er	Industrial	500 Studebaker Rd	183.7	113.9	4.0	455.5	Largest 50 Potable Customers
7B[1]	6	AES Southland LLC,	AES Southland LLC	No	Pow er	Industrial	6701 E 2nd St	169.3	104.9	4.0	419.8	Largest 50 Potable Customers
7B	15	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	1116 Stevely Ave	39.4	24.4	4.0	97.7	Largest 50 Potable Customers
							Project 7B Industrial Subtotal	1392.4	863.2		973.0	
7B	45	L B Unified School District	Walter Hill Middle School	Yes	School	Irrigation	1100 Iroquois Ave	20.2	12.6	7.4	92.6	All Potable Irrigation Customers
							Project 7B Irrigation Subtotal	20.2	12.6		92.6	
							Project 7B Total	1412.6	875.8		1065.7	

1 Customers on multiple proposed pipeline alignment options.

Table ES-2 (continued)
Potential Recycled Water Customers by Proposed Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
7C[1]	4	L A Department Water & Power	Haynes Generating Station	Yes	Power	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
7C[1]	6	AES Southland LLC,	AES Southland LLC	No	Power	Industrial	6701 E 2nd St	169.3	104.9	4.0	419.8	Largest 50 Potable Customers
							Project 7C Industrial Subtotal	1169.3	724.9			
7C	37	Yamaguchi, Terry	Bixby Village Golf Course	No	Golf	Irrigation	6151 Bixby Village Dr	23.1	14.3	7.4	105.6	All Potable Irrigation Customers
7C	9	U S Veterans Adm Hospital	Veterans Affairs Medical Hospital	No	Hospital	Irrigation	5901 E 7th St	74.3	46.1	7.4	339.9	Largest 50 Potable Customers
7C	32	Belmont Shores Investors LLC	Belmont Shores Investors LLC	No	Residential	Irrigation	6261 E Pacific Coast Hwy	23.9	14.8	7.4	109.2	Largest 50 Potable Customers
7C	13	Cal State University Long Beach	Cal State Long Beach	No	School	Irrigation	1250 Bellflower Blvd	45.0	27.9	7.4	205.9	Largest 50 Potable Customers
7C	28	Cal State University Long Beach	Cal State Long Beach	No	School	Irrigation	1250 Bellflower Blvd	27.0	16.8	7.4	123.6	Largest 50 Potable Customers
							Project 7C Irrigation Subtotal	193.3	119.8			
							Project 7C Total	1362.5	844.7		884.2	
							Project No. 7 Total	1605.9	995.6		3545.5	
Project No. 8												
8	7	American Textile Maint Company	American Textile Maintenance Co.	Yes	Commercial Laundry	Industrial	1340 Orizaba Ave	102.3	63.4	1.3	84.6	Largest 50 Potable Customers
							Project No. 8 Total	102.3	63.4		84.6	
Project No. 9												
9A	46	Hyatt Regency Hotel	Hyatt Regency Hotel	Yes	Hotel	Irrigation	200 S Pine Ave	20.0	12.4	7.4	91.4	Largest 50 Potable Customers
9A	12	Long Beach Parks Rec & Marine	Long Beach Shoreline Marina	Yes	Park	Irrigation	400 Shoreline Village Dr	50.4	31.3	7.4	230.7	All Potable Irrigation Customers
9A	38	L B Marine Bureau	Rainbow Harbor Esplanade	Yes	Park	Irrigation	290 S Pine Ave	22.5	14.0	7.4	103.0	All Potable Irrigation Customers
							Project 9A Total	92.9	57.6		425.1	
9B	24	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1755 Pier D Ave	29.0	18.0	2.0	36.0	Port of Long Beach Customer
9B[1]	3	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
9B[1]	23	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
							Project 9B Industrial Subtotal	453.1	280.9		1087.6	
9B	20	City of Long Beach	Cesar Chavez Elementary	Yes	School	Irrigation	910 W Broadway	34.7	21.5	7.4	158.6	All Potable Irrigation Customers
							Project 9B Irrigation Subtotal	34.7	21.5		158.6	
							Project 9B Total	487.7	302.4		1246.2	
9C[1]	1	BP West Coast Products	BP West Coast Products, Wilmington Calciner	No	Industrial	Industrial	1175 Carrack Ave	728.8	451.8	2.0	903.7	Port of Long Beach Customer
9C[1]	18	BP West Coast Products	BP West Coast Products, Wilmington Calciner	No	Industrial	Industrial	1175 Carrack Ave	37.6	23.3	2.0	46.6	Port of Long Beach Customer
9C[1]	22	National Gypsum Division	National Gypsum Division	No	Industrial	Industrial	1850 Pier B St	30.5	18.9	2.0	37.8	Largest 50 Potable Customers
							Project 9C Total	796.9	494.0		988.1	
9D	2	THUMS Long Beach	THUMS Long Beach	Yes	Oil	Industrial	1035 S Harbor Scenic Dr	592.0	367.0	2.0	734.0	Port of Long Beach Customer
9D	19	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1277 S Harbor Scenic Dr	36.0	22.3	2.0	44.6	Port of Long Beach Customer
							Project 9D Total	628.0	389.3		778.7	
							Project No. 9 Total	2005.5	1243.4		3438.0	
Project No. 10												
10[1]	3	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
10[1]	23	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
							Project No. 10 Total	424.1	262.9		1051.6	

1 Customers on multiple proposed pipeline alignment options.

Table ES-2 (continued)
Potential Recycled Water Customers by Proposed Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
Project No. 11												
11A	17	Golf Learning Center	Golf Learning Center	No	Golf	Irrigation	3701 Pacific Pl	38.0	23.5	7.4	173.7	2008-2009 Water Billing Data
11A	8	Memorial Medical Center	Memorial Medical Center	No	Hospital	Irrigation	2801 Atlantic Ave	77.0	47.7	7.4	352.3	Largest 50 Potable Customers
11A	48	L B Parks Bureau	Veterans Park Community Center	No	Park	Irrigation	101 E 28th St	19.5	12.1	7.4	89.3	All Potable Irrigation Customers
							Project 11A Total	134.5	83.4		615.3	
11B	10	Orange County Nursery Inc.	Orange County Nursery Inc.	No	Nursery	Irrigation	3400 Webster Ave	68.1	42.2	7.4	311.6	2008-2009 Water Billing Data
11B	39	L B Parks Recreation & Marine	L B Parks Recreation & Marine	No	Park	Irrigation	2205 W Hill St	21.7	13.5	7.4	99.4	All Potable Irrigation Customers
11B	41	L B Parks Bureau	Silverado Park	No	Park	Irrigation	1516 W 32nd St	21.5	13.4	7.4	98.6	All Potable Irrigation Customers
11B	25	Windw ard Village	Windw ard Village	No	Residential	Irrigation	1831 W Spring St	28.1	17.4	7.4	128.5	Largest 50 Potable Customers
11B	29	Springdale Preservation LTD	Springdale Preservation LTD	No	Residential	Irrigation	2095 W Spring St	25.6	15.9	7.4	117.0	Largest 50 Potable Customers
11B	47	L B Unified School District	Cabrillo High School	No	School	Irrigation	2001 Santa Fe Ave	19.7	12.2	7.4	90.1	Largest 50 Potable Customers
							Project 11B Total	184.7	114.5		845.1	
							Project No. 11 Total	319.2	197.9		1460.4	

1 Customers on multiple proposed pipeline alignment options.

These customers have either expressed interest in recycled water conversion or are located near an existing LBWD recycled water pipeline. The "most probable" customers are located along the highest ranked pipeline alternatives shown in **Table ES-3,** except customers from Alternative 9C (not included due to the questionable feasibility of converting a major customer along that pipeline to recycled water) and Medico Linen, which is located along an existing recycled water pipeline. The most probable customers have a total annual recycled water demand of 2,505 acre-ft.

Table ES-3
Prioritized Projects

Priority No.	Alternative	Total Demand by Alternative (acre-feet/yr)	Total Capital Costs ($)	Payback Period (years)
1	8	102	240,000	13
2	4	39	320,000	24
3	7B	1,413	7,590,000	29
4	7C	1,363	9,570,000	34
5	7A	1,000	7,010,000	38
6	6	20	250,000	38
7	1A	52	750,000	42
8	9A+9B+9C+9D	2,006	32,870,000	55
9	1A+1B	172	5,010,000	86
10	3	32	1,010,000	93
11	1A+1B+1C	216	7,010,000	96
12	9A+9C	925	23,950,000	125
13	5	24	1,120,000	137
14	9A+9D	756	22,400,000	140
15	9A+9B	581	19,800,000	155
16	2	21	1,140,000	157
17	11A	134	7,850,000	173
18	11B	185	12,390,000	199
19	9A	128	16,640,000	386

RECOMMENDATIONS

The following operational and infrastructure recommendations are presented for the expansion of LBWD's recycled water system:

Recycled Water Customers and Pipelines

Based on the cost evaluation and prioritization, in addition to Water Replenishment District's (WRD) LeoVanderLans Water Treatment Facility (LVL), 17 out of the 49 potential customers are identified as the "most probable customers" to be converted to recycled water in the near-term. These customers have either expressed interest in recycled water conversion or are located near an existing LBWD recycled water pipeline. The following future recycled water projects are recommended for implementation, in order from highest to lowest priorities. Other alternatives may also be implemented after these highest priority projects are completed:

Table ES-4
Most Probable Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
Project No. 1												
1A	11	L A County Community Develop	L A County Community Development	Yes	Residential	Irrigation	801 Via Carmelitos	52.3	32.5	7.4	239.5	Largest 50 Potable Customers
							Project No. 1A Total	52.3	32.5		239.5	
Project No. 4												
4	16	L B Unified School District	Milliken High School	Yes	School	Irrigation	2800 Snow den Ave	39.3	24.4	7.4	180.0	All Potable Irrigation Customers
							Project No. 4 Total	39.3	24.4		180.0	
Project No. 6												
6	49	Long Beach Airport Marriott	Long Beach Airport Marriott	Yes	Hotel	Irrigation	4700 Airport Plaza Dr	19.5	12.1	7.4	89.2	Largest 50 Potable Customers
							Project No. 6 Total	19.5	12.1		89.2	
Project No. 7												
7A[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
							Project 7A Total	1000.0	620.0		2479.8	
7B[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
7B	15	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	1116 Stevely Ave	39.4	24.4	4.0	97.7	Largest 50 Potable Customers
							Project 7B Industrial Subtotal	1039.4	644.4		97.7	
7B	45	L B Unified School District	Walter Hill Middle School	Yes	School	Irrigation	1100 Iroquois Ave	20.2	12.6	7.4	92.6	All Potable Irrigation Customers
							Project 7B Irrigation Subtotal	20.2	12.6		92.6	
							Project 7B Total	1059.6	656.9		190.3	
							Project No. 7 Total	1059.6	656.9		190.3	
Project No. 8												
8	7	American Textile Maint Company	American Textile Maintenance Co.	Yes	Commercial Laundry	Industrial	1340 Orizaba Ave	102.3	63.4	1.3	84.6	Largest 50 Potable Customers
							Project No. 8 Total	102.3	63.4		84.6	
Project No. 9												
9A	46	Hyatt Regency Hotel	Hyatt Regency Hotel	Yes	Hotel	Irrigation	200 S Pine Ave	20.0	12.4	7.4	91.4	Largest 50 Potable Customers
9A	12	Long Beach Parks Rec & Marine	Long Beach Shoreline Marina	Yes	Park	Irrigation	400 Shoreline Village Dr	50.4	31.3	7.4	230.7	All Potable Irrigation Customers
9A	38	L B Marine Bureau	Rainbow Harbor Esplanade	Yes	Park	Irrigation	290 S Pine Ave	22.5	14.0	7.4	103.0	All Potable Irrigation Customers
							Project 9A Total	92.9	57.6		425.1	
9B	24	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1755 Pier D Ave	29.0	18.0	2.0	36.0	Port of Long Beach Customer
9B	3	Montenay Pacific Pow er Corp	Montenay Pacific Pow er Corp	Yes	Pow er	Industrial	100 Henry Ford Ave	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
9B	23	Montenay Pacific Pow er Corp	Montenay Pacific Pow er Corp	Yes	Pow er	Industrial	100 Henry Ford Ave	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
							Project 9B Industrial Subtotal	453.1	280.9		1087.6	
9B	20	City of Long Beach	Cesar Chavez Elementary	Yes	School	Irrigation	910 W Broadw ay	34.7	21.5	7.4	158.6	All Potable Irrigation Customers
							Project 9B Irrigation Subtotal	34.7	21.5		158.6	
							Project 9B Total	487.7	302.4		1246.2	
9D	2	THUMS Long Beach	THUMS Long Beach	Yes	Oil	Industrial	1035 S Harbor Scenic Dr	592.0	367.0	2.0	734.0	Port of Long Beach Customer
9D	19	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1277 S Harbor Scenic Dr	36.0	22.3	2.0	44.6	Port of Long Beach Customer
							Project 9D Total	628.0	389.3		778.7	
							Project No. 9 Total	1208.6	749.3		2449.9	

1. Alternative 8 – Pipeline to American Textile Maintenance Company (Commercial Laundry)
2. Alternative 4 – Pipeline to Millikan High School
3. Alternative 7 – Pipeline to LADWP's Haynes Generating Station
4. Alternative 6 – Pipeline to Long Beach Marriott Hotel
5. Alternative 1A – Pipeline to Los Angeles County Community Development
6. Alternative 9 – Pipeline to Downtown Long Beach and Port of Long Beach (THUMS, Montenay Pacific Power Corporation, and possibly BP West Coast Products as the anchor customers)

The capital costs for the pipeline alternatives that serve the "most probable customers" in the near term are presented in **Table ES-5**.

Table ES-5
Capital Costs for Near-Term Pipeline Projects

Alternative	Total Demand by Alternative (acre-feet/year)	Total Capital Costs ($)
1A	52	750,000
4	39	320,000
6	20	250,000
7A	1,000	7,010,000
7B	1,413	7,590,000
8	102	240,000
9A	128	16,640,000
9A+9B	581	19,800,000
9A+9D	756	22,400,000

Notes: Total construction costs represent year 2010 costs.
Alternative 9B can be constructed only after Alternative 9A is constructed.
Alternative 9D can be constructed only after Alternative 9A is constructed.

Additionally, the following customers located along existing recycled water pipelines should be connected:

- Medico Professional Linen is a potential customer with an estimated recycled water demand of 1.3 gallons per minute (gpm)

South Lake Pump Station

Based on the results of hydraulic modeling for future demand conditions, it is observed that there are certain areas with low pressures (< 40 psi) in the western reaches of LBWD's recycled water system. It is recommended that the South Lake Pump Station be operated continuously to maintain system pressures in the western reaches of the system under future demand conditions. Due to the age of the station, in order to use it on a regular basis, it is recommended that the pump station be rehabilitated, including pump replacement, addition of variable frequency drives (VFD), and upgrades to the electrical equipment. It is recommended that the South Lake pump station be operated such that system pressures at the Longfellow Elementary school are maintained at 40 psi. If this is not feasible operationally, then it is recommended that a discharge pressure of 80 psi be maintained at the pump station.

El Dorado Pump Station

Due to the significant variation in recycled water supplies over the course of the day, it is recommended that VFDs be installed at the El Dorado Pump Station to pace the flow out of the pump station to the flows available from LACSD. This would assist the operators in obtaining better control over the operation of the pumps, use as much flow as possible, and limit fluctuations in system pressures. It is estimated that adding VFDs at the existing pumps would cost approximately $225,000. No capacity recommendations are included for El Dorado Pump Station.

Recycled Water Storage

It is recommended that LBWD plan for two recycled water storage reservoirs (3.3 MG each) at the Alamitos reservoir site to meet the storage needs of all potential recycled water customers (excluding the proposed expansion at WRD's LVL facility). The storage analysis reveals that the first additional 3.3 MG reservoir will be required when 4.4 mgd of future demand (in addition to the existing recycled water demand) is added to the recycled water system. The second additional 3.3 MG reservoir will be required when 5.8 mgd of future demand (in addition to the existing recycled water demand) is added to the recycled water system. **Table ES-6** presents the estimated costs for the recommended reservoirs.

Table ES-6
Capital Costs for Near-Term Pipeline Projects

Description	Total Capital Costs ($)
Two 3.3 MG Steel Reservoirs at the Alamitos Reservoir site	2,500,000 (per reservoir)

Notes: Total construction costs represent year 2010 costs.

In the near-term, it is expected that the "most probable" customers and WRD's proposed expansion at the Leo VanderLans (LVL) treatment facility would account as potential demands for LBWD's recycled water system. Storage analysis for LBWD's "most probable" customers indicates that the existing storage at the Alamitos reservoir site is sufficient to meet near-term storage requirements of LBWD's potential customers.

Demand Management

It is recommended that LBWD implement demand management measures under future demand conditions which requires customers causing huge peaks in demands to shift their usage to another time period over the course of the day. Implementing such measures will help reduce pressure fluctuations in the system and will address the low pressure issues (< 40 psi) under future demand conditions in the northwestern area of the system.

Pressure Monitoring

In order to monitor system pressures for the recycled water system, it is recommended that LBWD install pressure monitors at Longfellow Elementary School and Heartwell Park.

Section 1
Introduction

This section provides an overview of the Long Beach Water Department's (LBWD) Recycled Water Master Plan (RWMP). A brief discussion of the scope of work, a description of the report sections to follow, and a listing of abbreviations and definitions used in this report are included in this section.

1.1 PROJECT BACKGROUND

In 1978, LBWD created a recycled water program to help meet the needs of a growing population. Recycled water studies were conducted in 2003 to quantify the available recycled water from the Long Beach Water Reclamation Plant (LBWRP) and to identify potential future customers. Current demand for recycled water has increased to approximately 6,000 acre-feet per year which has resulted in LBWD experiencing shortages during the summer months.

The RWMP is jointly funded by the LBWD and the Water Replenishment District of Southern California (WRD). WRD uses recycled water supplied by LBWD at its Leo VanderLans (LVL) treatment facility for the purposes of sea-water barrier injection. Currently, a blend of imported water and recycled water is used for the purposes of sea-water barrier injection. A proposed expansion of the LVL treatment facility is currently being planned. The intent of this expansion is to replace the imported water used for the sea-water barrier injection with recycled water. It is expected that the expanded facility will have a treatment capacity of approximately 7.6 million gallons per day (mgd) which is approximately two times the current treatment capacity of 3.8 mgd.

The intent of this study is to develop a RWMP for LBWD's service area that will assist LBWD staff to identify potential recycled water customers and the required recycled water infrastructure to meet future demands. In addition, the study will determine the amount of recycled water that is available to WRD's LVL facility under different demand and storage conditions in the future.

1.2 SCOPE OF WORK

The scope of work for this RWMP includes the following tasks.

- Inspection of LBWD's facilities
- Review of flows at the LBWRP
- Review of historical recycled water demands
- Identification of potential recycled water customers
- Hydraulic model calibration
- Comparison of supply and demands
- Review of pumping and storage facilities
- Development of alternatives and evaluation
- Development of a final RWMP report

1.3 DATA SOURCES

In preparation of this RWMP, LBWD staff supplied data including billing data and detailed facility information, geographic information systems (GIS) data for all facilities, a copy of LBWD's existing hydraulic model in H_2ONET, and supervisory control and data acquisition (SCADA) data for LBWD's facilities. Effluent data from the LBWRP was obtained from the Sanitation Districts of Los Angeles County (LACSD). Several meetings were held with LBWD and WRD staff over the course of the project to review and discuss assumptions and to gather additional information.

1.4 AUTHORIZATION

This RWMP has been developed in accordance with a purchase requisition between LBWD and MWH dated December, 21, 2009.

1.5 ACKNOWLEDGMENTS

MWH wishes to acknowledge and thank all LBWD staff for their support and assistance in completing this project with special thanks to Eric Leung, (Director of Water Resources), and Chris Pincherli (Senior Program Manager).

MWH also wishes to acknowledge and thank the WRD staff for their support and assistance in this project with special thanks to Paul Fu (Senior Engineer), and Jim McDavid (Senior Engineer).

1.6 PROJECT STAFF

The following MWH staff was principally involved in the preparation of this RWMP:

Principal-in-Charge:	Ajit Bhamrah, P.E.
Project Manager:	Matthew Huang, P.E.
Project Engineers:	Ganesh Krishnamurthy, E.I.T.
	Jinny Huang, P.E.
	Parag Kalaria, E.I.T.
Technical Review:	Jim Stahl, P.E.
	Don Bassett, P.E.
	David Bouck, P.E.
	Alok Pandya, P.E., PMP

1.7 RECYCLED WATER MASTER PLAN OUTLINE

The organization of the RWMP is as follows:

- **Section 2** discusses LBWD's existing system facilities, the hydraulic model development and calibration process including calibration results.
- **Section 3** summarizes the available recycled water supplies and resolves data inconsistencies on available recycled supplies.

- **Section 4** describes the existing recycled water customers within LBWD's service area, defines peaking factors for the existing recycled water system, and recommends peaking factors for sizing capital improvement facilities.
- **Section 5** describes the identification of potential future recycled water customers and estimates their recycled water use.
- **Section 6** develops pipeline alternatives to serve the potential customers and presents an economic analysis ranking each alternative based on its economic feasibility.
- **Section 7** compares future recycled water demands and available supplies, estimates the amount of recycled water available to WRD, and determines the storage capacity required under different demand conditions.
- **Section 8** summarizes the recommendations made in the report.

1.8 ACRONYMS AND ABBREVIATIONS

To conserve space and improve readability, abbreviations have been used in this report. Each abbreviation has been spelled out in the text the first time it is used. Subsequent usage of the term is usually identified by its abbrevation. The abbreviations used are shown in **Table 1-1**.

Table 1-1
Acronyms and Abbreviations

Abbreviation	Explanation
AACE	Advancement of Cost Engineering
acre-ft/year	acre-feet per year
ADD	Average day demand
Ave	Avenue
Blvd	Boulevard
CT	Contact time
DEM	Digital elevation
Dr	Drive
E	East
fps	feet per second
ft	feet
gpm	gallons per minute
hr	Hour
Hwy	Highway
LACSD	Los Angeles County Sanitation District
LBWD	Long Beach Water District
LBWRP	Long Beach Water Reclamation Plant
LLC	Limited liability company
Ltd	Limited company
LVL	Leo VanderLans Water Treatment Facility
max	Maximum
MDD	Maximum day demand
MG	Million gallon
mgd	million gallons per day
min	Minimum
MMD	Maximum month demand
No.	Number
PHD	Peak hour demand
psi	Pounds per square inch
Rd	Road
RWMP	Recycled Water Master Plan
SCADA	Supervisory Control and Data Acquisition
St	Street
VFD	Variable Frequency Drive
W	West
WRD	Water Replenishment District of Southern California

Section 2
Existing Recycled Water Facilities and Model Calibration

2.1 INTRODUCTION

This section summarizes the physical condition and existing system operations of the Long Beach Water Department's (LBWD) recycled water system facilities based on the information gathered from field visits, existing reports, and input from LBWD staff. A field visit was conducted on February 10, 2010 to assess the physical conditions of the facilities and to understand the system operations. Photographs taken during the site visit are provided in **Appendix A**. A hydraulic model has been developed and calibrated for the LBWD recycled water system and is also discussed in this section.

2.2 RECYCLED WATER SYSTEM OVERVIEW

LBWD has been providing recycled water from the Long Beach Water Reclamation Plant (LBWRP) since the 1980s to customers in its service area, and was among the first to do so in Southern California. From serving just one City park, the recycled water customer base and distribution have grown to include other public and private irrigation customers, such as parks, schools, golf courses, cemeteries, and garden nurseries, as well as the repressurization of offshore oil bearing strata. The LBWD has approximately 90 recycled water service connections with a maximum month demand of seven million gallons per day (mgd). The two largest customers are Leo VanderLans Treatment Plant (Water Replenishment District use for Alamitos barrier) and THUMS with average demands of two mgd and one mgd respectively. LBWD's recycled water system consists of:

- Two Pressure Zones
- Approximately 26 miles of pipeline ranging from 6 to 36-inches in diameter
- Three above-ground 3.3 million gallon (MG) steel storage tanks located at the Alamitos Reservoir Hill Storage Facility
- Three booster pump stations: El Dorado and THUMS pump stations, both located at LBWRP, and another booster pump station at South Lake in the Lakewood Country Club Golf Course
- One backup booster pump station which supplies groundwater via El Dorado Lake as a backup supply to the recycled water system during emergency
- One groundwater well; El Dorado park well, which supplies untreated groundwater for El Dorado Park Lake makeup following pumping of water from the lake by the emergency backup pump station
- Control valves and other appurtenances

LBWD's primary recycled water supply is met by the effluent from the LBWRP, which is owned and operated by Sanitation Districts of Los Angeles County (LACSD). The recycled water is pumped from the chlorine contact basin at the LBWRP by the El Dorado/THUMS Pump Station. A schematic of the recycled water system is shown in **Figure 2-1**.

2.3 SUMMARY OF EXISTING FACILITIES

LBWD's recycled water delivery system consists of approximately 26 miles of transmission mains, ranging from 6 inches to 36 inches in diameter. The transmission main network is divided into the North Branch System and the South Branch System. In the upper pressure zone, the North Branch System terminates at Virginia Lake. The South Branch System terminates at the intersection of Obispo Avenue and Second Street. Both the north and south systems are interconnected and operates as a single system. **Figure 2-2** shows the map of LBWD's recycled water system. Information regarding system attributes such as pipeline material, length, year of installation and diameter is obtained from LBWD's Geographic Information System (GIS) database. A majority of the recycled water system has been built in the last 40 years and is in fair condition.

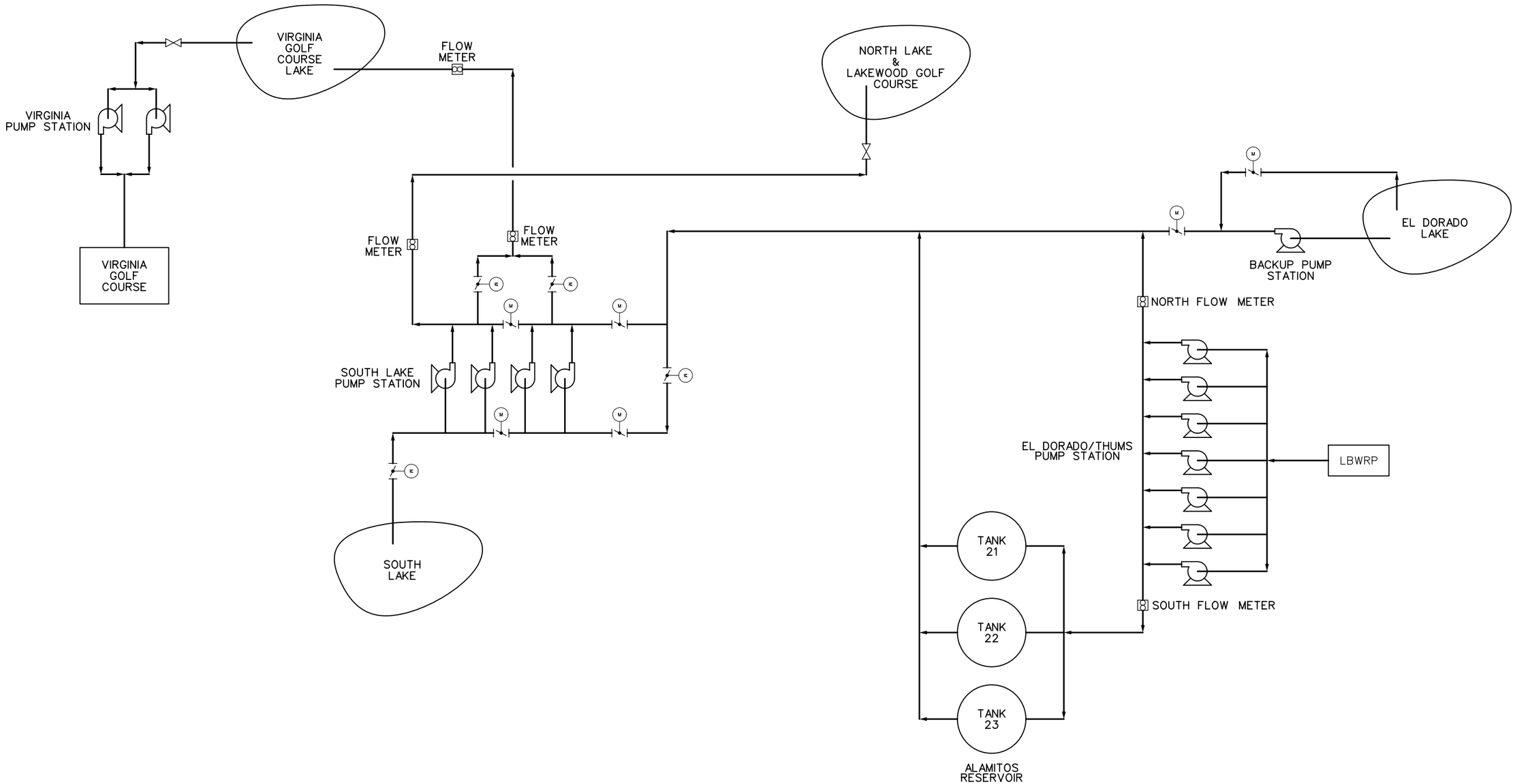
A summary of pipeline materials in LBWD's recycled water system is presented on **Figure 2-3**. Approximately 58 percent of the pipelines in the LBWD's system are steel pipes. All pipelines that do not have a material type populated in the GIS database are categorized as "unknown" material.

2.3.1 Recycled Water Booster Stations

2.3.1.1 El Dorado and THUMS Pump Stations

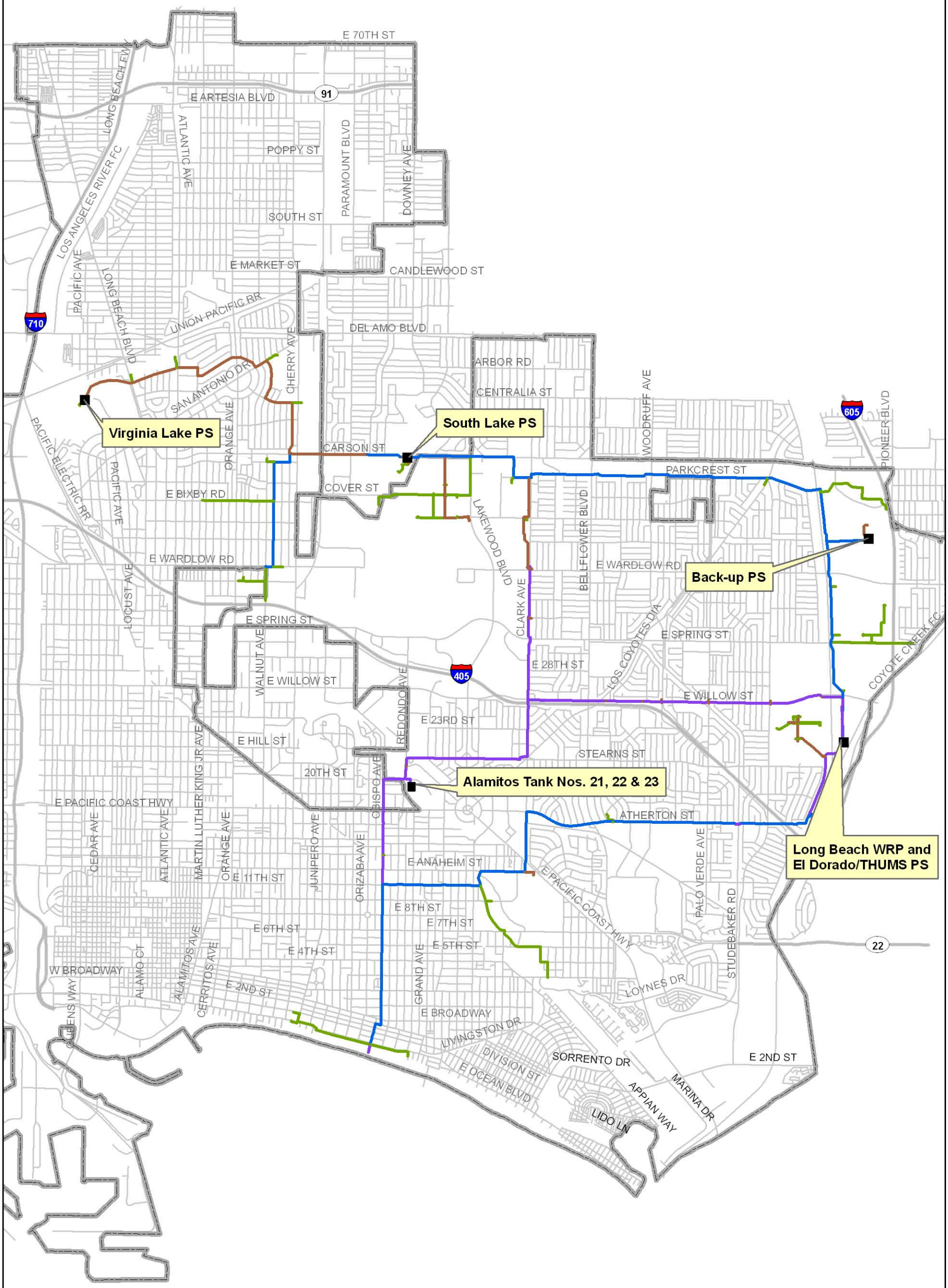
The existing pump stations (El Dorado and THUMS) located at the LBWRP site supplies primary recycled water to the Long Beach recycled water system. The El Dorado pump station is equipped with five and THUMS pump station is equipped with two vertical turbine, multiple stage pumps. Each pump has the capacity to pump 2,500 gpm at 190 feet of head. The summary of the system facilities is presented in **Table 2-1**. All of the pumps are equipped with 150 hp motors and variable frequency drives. The five pumps at the El Dorado pump station are outside on a concrete slab at the south end of the plant site. The El Dorado pump station has a provision to accommodate a sixth pump with minor modifications. Effluent from the plant's three chlorine contact tanks flows directly to the El Dorado pump station via a 36-inch diameter line.

The THUMS pump station is equipped with two pumps housed inside a brick building. The THUMS pump station also houses the control panel, and all electrical appurtenances for both El Dorado and THUMS pump stations. It was noted during the field visit that one of the pumps at the THUMS pump station was locked out and the other pump was not operational. The reason for the non-operation of this station was not identified during the field visit. It is recommended that LBWD identify and resolve the problem and maintain both pumps in operation at the THUMS pump station.



LBWD RECYCLED WATER MASTER PLAN

FIGURE 2-1
EXISTING RECYCLED WATER SYSTEM



This map has been designed to print size 11'' by 17''.

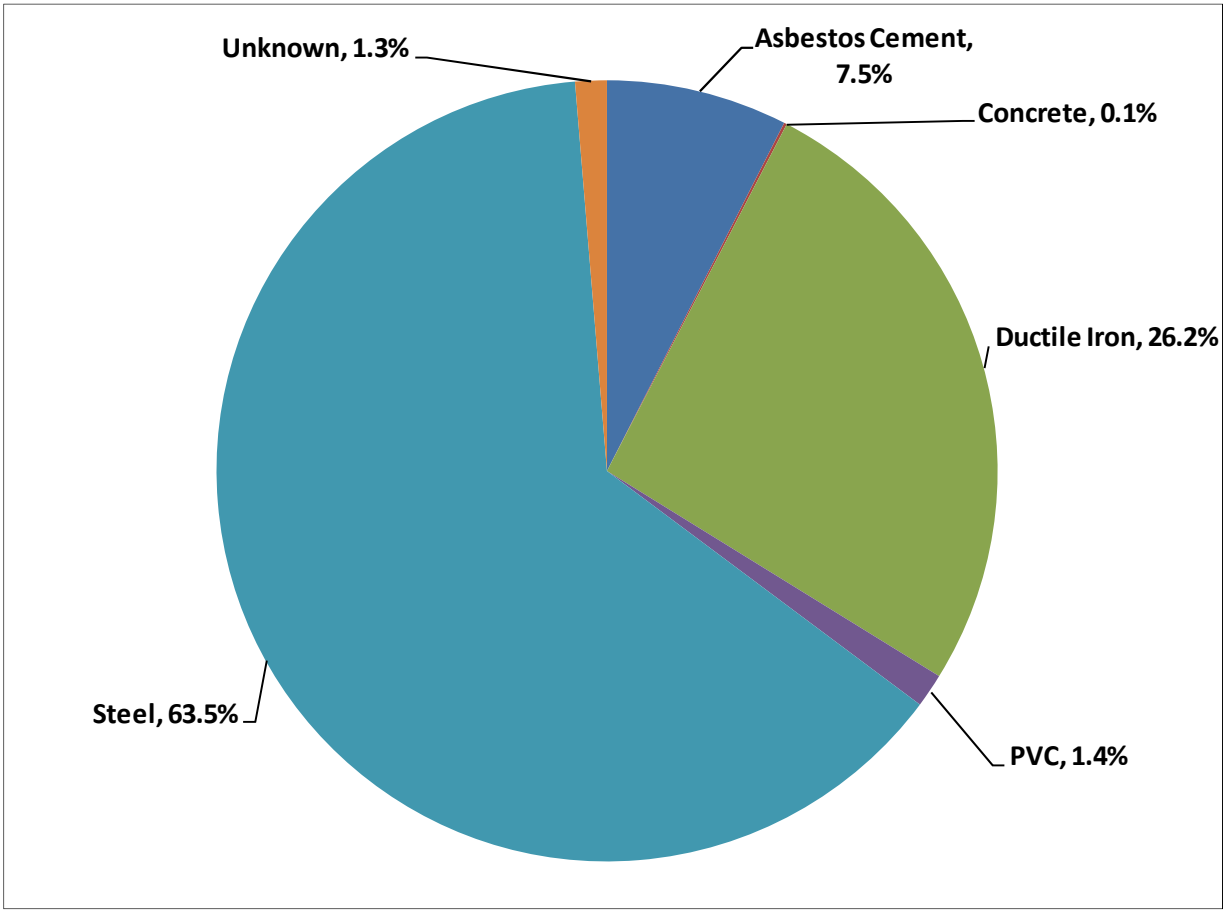


Figure 2-3
Summary of Pipelines by Material

The El Dorado/THUMS pump stations are currently operated based on the level in the recycled water storage tanks as well as the level in the chlorine contact basin. The chlorine contact basin needs to maintain a certain minimum depth of water in order to meet the Chlorine Contact Time (CT) requirements. The automatic control of the pump station is set to operate based on the level of the storage tanks. However, the chlorine contact basin levels are observed to ensure that the minimum level is maintained.

Due to the significant variation in recycled water supplies over the course of the day, it is recommended that VFDs be installed at the El Dorado Pump Station to pace the flow out of the pump station to the flows available from LACSD. This would assist the operators in obtaining better control over the operation of the pumps, use as much flows as possible, and limit fluctuations in system pressures.

Table 2-1
Summary of Facilities

Booster Pump Station			
	El Dorado/THUMS Pump Station	**Backup Pump Station**	**South Lake Pump Station**
Location	LBWRP	El Dorado Park	Lakewood Country Club
No. of Pumps	7	1	4
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine
Number of Stages (each)	3	3	6
Rated Flow (gpm, each)	2,500	2100	1200
Rated Head (feet, each)	189	255	310
No. of Motors and Drives	7	1	4
Horsepower (each)	150	200	125
Nominal Speed (rpm each)	1,800	1800	1800
Lakes			
	South Lake	**Virginia Lake**	
Location	Lakewood Country Club	Virginia Country Club	
Type	Open	Open	
Volume	2	3	
Reservoir			
Location	Alamitos Reservoir		
Number of Storage Tanks	3		
Type (each)	Above Ground		
Material (each)	Steel		

2.3.1.2 Backup Pump Station

A backup pump station located at the El Dorado Park East can be used to supply groundwater to the system. A nearby potable water well (Commission 20 Well) discharges groundwater via an air gap to the northern lake at the park. The emergency backup pump station is used to maintain water supply to the users during periods of limited recycled water availability. Based on the information from the SCADA system, the pump station is used very infrequently.

The backup pump station consists of a vertical-turbine, multiple stage pump with a 200 hp motor and adjustable frequency drive. The rated capacity of this pump is 2,100 gpm at 255 feet of head. The pump is surrounded by a block wall and chain link fence enclosure.

2.3.1.3 South Lake Booster Pump Station

The South Lake Pump Station is located at South Lake at the Lakewood Country Club Golf Course. Recycled water can either be discharged into the South Lake or can be bypassed directly to the distribution system. Four vertical-turbine, multiple stage pumps (having a capacity of 1,200 gpm each) located at the South Lake Pump Station serve the customers in Lakewood and

Virginia Lake. Each pump is rated at 1,200 gpm at 310 feet of head. The pumps usually discharge at about 105 psi.

The pump station is located in a building with masonry wall and each pump has a 125 hp motors with a variable frequency drive to meet daily demand variations. The pumps can take suction either directly from the upstream recycled water distribution system or from South Lake. Recycled water flows by gravity into the lake.

Under normal operating conditions, if there is sufficient pressure in the recycled water system, the water flows directly to Lakewood and other Virginia Lake customers along the pipeline. During low pressure conditions, the pump station operates to deliver recycled water to meet the demands of Lakewood, customers along the pipeline, and Virginia Lake. In the event that there is not enough supply in the recycled water system, the pump station will draw water from the South Lake to meet system demands for Lakewood and Virginia Lake. The amount of water drawn from the South Lake is supplied back to the lake when sufficient flows are available in the recycled water system. South Lake is an open reservoir with a volume of about 2 million gallons.

This pump station has not been used on a regular basis in the past; if LBWD desires to use the pump station on a regular basis, upgrades are required at the pump station. Due to the age and conditions of the pump station, the pumps should be replaced, variable speed drives upgraded to variable frequency drives (VFDs), and electrical equipment upgraded. The pump station is adequate as is if it is only used for standby purposes.

2.3.1.4 Virginia Lake

Recycled water from the South Lake Booster Station is supplied to customers in the Virginia Lake. There is a flow meter measuring the flow discharged into Virginia Lake. Recycled water is pumped from Virginia Lake to serve recycled water to the golf course.

2.3.2 Recycled Water Storage Reservoirs

2.3.2.1 Alamitos Reservoir

Three above ground steel recycled water storage tanks are located at Alamitos Reservoir Hill Storage Facility. The size of each storage tank is 3.3 MG. The visually observed condition for all three tanks is good. These storage tanks provide the required operational storage to meet the seasonal and daily variations.

2.4 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

LBWD presently uses a computerized SCADA system to control all facilities including storage tanks, Pump stations and distribution facilities. The SCADA system is located at the LBWD's operations office.

The SCADA system can only be accessed at the central control center, located at the Groundwater Treatment Plant, and can currently monitor the below mentioned information:

- North Flow Meter at El Dorado Pump Station
- South Flow Meter at El Dorado Pump Station
- Level of Chlorine Contact Basin
- El Dorado Pump Station Discharge Pressure
- Back-up Reclaim Pump Station Pressure
- Back-up Reclaim Pump Station Flow
- Back-up Lake Level
- South Lake Suction Pressure
- South Lake Discharge Pressure
- South Lake System Pressure
- South Lake – Influent Flow
- South Lake – Level
- South Lake Flow to Virginia
- Virginia Lake Pressure
- Virginia Lake - Influent Flow
- Virginia Lake level
- Tank 22 level
- Tank 23 level

2.5 SYSTEM RECOMMENDATIONS:

Based on discussion with LBWD staff, review of SCADA data, and a field inspection of the facilities, the following recommendations are made:

- Identify and rectify the problem for lock out and non-operation of pumps at the THUMS Pump Station.
- Calibrate the north and south flow meters at El Dorado Pump Station once every three years.
- Pressure monitoring stations at Longfellow Elementary School and Heartwell Park.
- VFDs at the El Dorado/THUMS Pump Station
- Upgrade South Lake Pump Station

2.6 MODEL DEVELOPMENT AND CALIBRATION

2.6.1 Model Development

A hydraulic model of the LBWD recycled water system was developed using Bentley's WaterGEMS V8 XM Edition (Version 08.09.400.34). The pipelines are exported from LBWD's previous recycled water hydraulic model developed in MWHSoft's H2ONet software. Existing

customer demands are included as junctions in the hydraulic model, with the pipelines used to connect the existing customers. Model elevations are based on USGS 7.5 meter digital elevations (DEMs). Existing facility information is based on data from the previous model and record drawings. Operational controls are based on field data and SCADA information. Flow is input into the model as a demand junction with negative flows (i.e., supply source). Customer demands are average annual values based on the average of fiscal years 2007 through 2009.

Potential customers are also added as recycled water demands in the model. Proposed pipelines to serve these customers are also included in the model. These customers are discussed in **Section 5** and the proposed pipeline alternatives are discussed in **Section 6**.

Diurnal curves are developed for the different user types, including two different irrigation patterns for different areas of LBWD's recycled water system, recycled water injection at THUMS, and recycled water use for the sea-water barrier injection at WRD's Leo VanderLans (LVL) Treatment facility. The diurnal patterns are provided in **Appendix B**.

2.6.2 Model Calibration

The hydraulic model is calibrated based on SCADA data received from LBWD. Calibration of the model is performed based on flow data gathered during the week between Friday, August 7th through Thursday, August 13th. Nine sites throughout the distribution system are chosen for flow or pressure comparisons. The locations of the comparison points are listed below and comparison graphs are provided in **Appendix C.**

1. Alamitos Reservoir levels
2. Chlorine Contact Basin levels
3. El Dorado Pump flows
4. Flows going north of the El Dorado pump station (i.e., North Flow Meter)
5. Flows going south of the El Dorado pump station (i.e., South Flow Meter)
6. Virginia Pump pressures
7. Flows to the north-west area of the distribution system (i.e., South Lake to Virginia flow)
8. South Lake pressures
9. Back-up Pump Station pressures,

Section 3
Existing Recycled Water Supplies

3.1 INTRODUCTION

The primary source of recycled water for the Long Beach Water District (LBWD) is the Long Beach Water Reclamation Plant (LBWRP) located at 7400 East Willow Street in Long Beach. The Los Angeles County Sanitation District (LACSD) owns and operates the LBWRP and produces a tertiary treated effluent in compliance with Title 22 requirements. This section discusses the existing recycled water supply and provides a comparison of the available supply based on data obtained from LACSD and LBWD's SCADA system.

3.2 EXISTING RECYCLED WATER SUPPLY SOURCES

LBWRP, the primary source of recycled water to LBWD's customers, is owned and operated by LACSD and is located north of the confluence of Coyote Creek and the San Gabriel River. The plant has a design capacity of 25 million gallons per day (mgd). LACSD has the ability to route additional flows to LBWRP, however currently there are no plans to do so on a regular basis and thus the availability of additional flows to LBWRP is not accounted in this study. Treatment at the LBWRP consists of primary sedimentation, activated sludge biological treatment, secondary sedimentation, coagulation, filtration, chlorination, and dechlorination (effluent going to Coyote Creek). Recycled water going to LBWD is not dechlorinated; excess effluent that is not reused by LBWD is dechlorinated and discharged to Coyote Creek. The removed sewage solids are returned to the trunk sewer for downstream treatment and disposal at LACSD's Regional Joint Water Pollution Control Plant located in Carson.

The recycled water is drawn from the chlorine contact basin through a 36-inch effluent line to LBWD's El Dorado/THUMS pump station. Downstream of the chlorine contact basin, LACSD also uses recycled water for utility demands which include irrigation demands around the LBWRP. There is no flow meter available to measure the quantity of recycled water used to meet utility demands. Based on the input from LBWRP's operations staff, the amount of water used to meet utility demands is approximately 0.5 mgd.

Based on an agreement between LBWD and County Sanitation District No. 2 of Los Angeles County dated August 28, 1968, LBWD has the rights to all of the effluent from the LBWRP at no cost to LBWD.

3.3 OTHER NON-POTABLE WATER SUPPLY SOURCES

Groundwater is another water source which can be used during emergencies to supplement recycled water. When there are insufficient recycled water supplies (historically, groundwater has been used for a couple of days every few years), groundwater is used to supplement LBWD's recycled water system. One of LBWD's potable wells, Commission 20 Well, is pumped and discharged into a lake at El Dorado Park East via an air gap. LBWD's backup recycled water pumping station then pumps from the El Dorado Park lake into the recycled water

system as a supplement. Groundwater from this source is accounted against LBWD's Central Basin pumping allocation, and LBWD must pay the cost of water.

Potable water has been used to supply the recycled water reservoir at the Alamitos Reservoir Hills site. Temporary pumps are used to pump from potable back-up supply to feed the recycled water reservoir when levels are low.

3.4 RECYCLED WATER QUANTITIES

This subsection quantifies recycled water quantities available from the LBWRP for recycled water uses under existing conditions. LACSD provided flow data on an hourly basis for the time frame of February 2009 to February 2010, with data not available for some intermediate dates. In order to accurately estimate the quantities of recycled water flows, a comparison of available flow and level data is performed for the months of October and November 2009. **Table 3-1** shows the data obtained from LBWD and LACSD's SCADA systems for the supply comparison.

Table 3-1
Available LBWD and LACSD SCADA Data

LBWD SCADA DATA	LACSD SCADA DATA
El Dorado/THUMS North Flow	Filter Effluent Flow
El Dorado/THUMS South Flow	Water Reuse Flow
Chlorine Contact Basin Level	Flow to Coyote Creek
	Chlorine Contact Basin Level

The following two sources of data are compared to verify the amount of available supply:

- LACSD Water Reuse Flow versus Eldorado/THUMS North + South Flow.
- Filter Effluent Flow versus LACSD Water Reuse Flow + Flow to Coyote Creek ± Change in Chlorine Contact Storage + Utility Water Flow.

The above mentioned comparison was done for each hour from October 15, 2009 to November 22, 2009. **Figure 3-1** shows a comparison between LACSD's water reuse flows and LBWD's El Dorado flows (sum of North and South Flow Meters.) The average flow measured by LACSD's flow meter and flow measured at El Dorado pump station shows a linear relationship with a slope close to one. Therefore, the data obtained from LBWD's two flow meters match the flows from LACSD's reuse flow meter, and either can be used to represent the actual amount of flow historically used by LBWD. Temporary ultrasonic flow meters were installed on February 25, 2010 in order to verify the flow readings from LBWD's meters, but accurate readings could not be obtained from the portable flow meters. The average flows for LACSD reuse flow and LBWD's reuse flow (sum of North and South Flow Meters) for the month of October and November 2009 are 5.99 mgd and 5.91 mgd respectively.

Figure 3-2 compares different meters calculating the total amount of flow available to LBWD. Flow from LBWRP filter effluent flow is compared with a sum total of water reuse flow (from LACSD) plus flow to Coyote Creek, adjusted for the change in chlorine contact basin levels and flows for LBWRP utility water. This comparison shows that there is no difference in the flow measured at the filter effluent and the consumed flow.

Thus, it can be stated that filter effluent flow minus the utility water flow of 0.5 mgd is representative of the available recycled water supply. The average flow for LACSD measured reuse flow plus Flow to Coyote Creek, adjusted for the change in chlorine contact basin levels and flows for LBWRP utility water is 17.7 mgd and Filter Effluent Flow is 17.4 mgd.

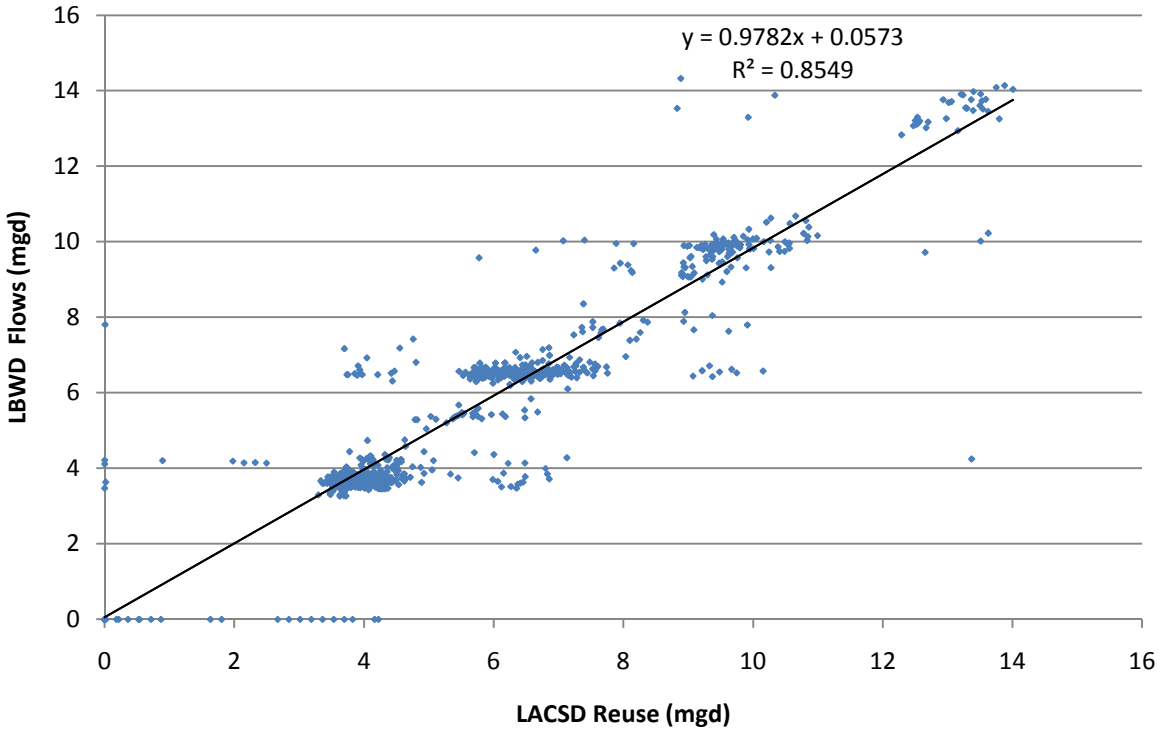


Figure 3-1
Comparison of LACSD and LBWD Measurement of Reuse[1]

[1] The graph is plotted for each hour from October 15, 2009 to November 22, 2009.

3.5 SUPPLY AVAILABILITY EVALUATION

Under existing conditions, the primary source of recycled water supply is from LBWRP, and based on the evaluation of the comparison of various data sources, the flow measured at filter effluent minus the utility water flow (0.5 mgd) is used as the most accurate representation of the available supply to LBWD. LACSD provided hourly filter effluent data from February 2009 to February 2010, with some intermediate dates not available. The hourly data flow and level data obtained from LACSD and LBWD are used to perform this evaluation. Reliability, water quality, and the effect of conservation on recycled water supplies are not considered in this evaluation.

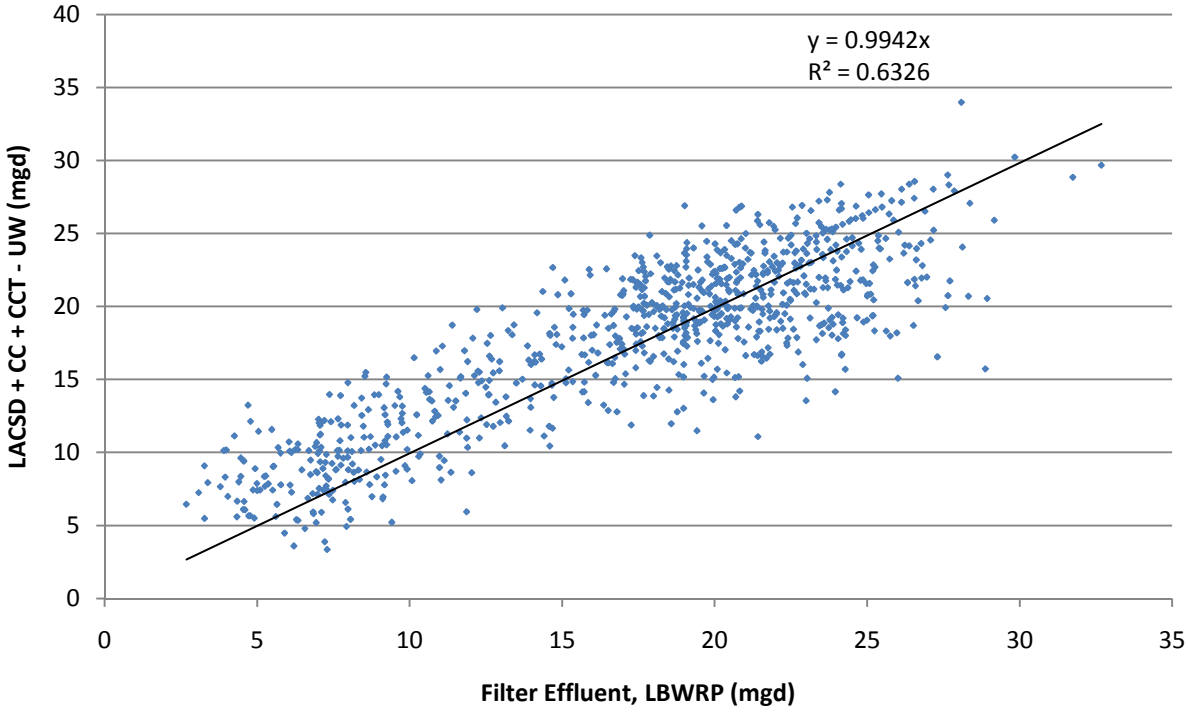


Figure 3-2
Comparison of Two Methodologies to Calculate Available Flow from LBWRP (LACSD Reuse plus Coyote Creek, Adjusted for Chlorine Contact Basin Levels and Utility Water versus and Filter Effluent) [1]

[1] The graph is plotted for each hour from October 15, 2009 to November 22, 2009.

3.5.1 Day of the Week and Monthly Patterns

Figure 3-3 shows the graph of average hourly filter effluent flow by the day of the week. The graph shows that the available supply and pattern are consistent during weekdays. The available supply from LBWRP over the weekends is slightly higher than the available supply on the weekdays.

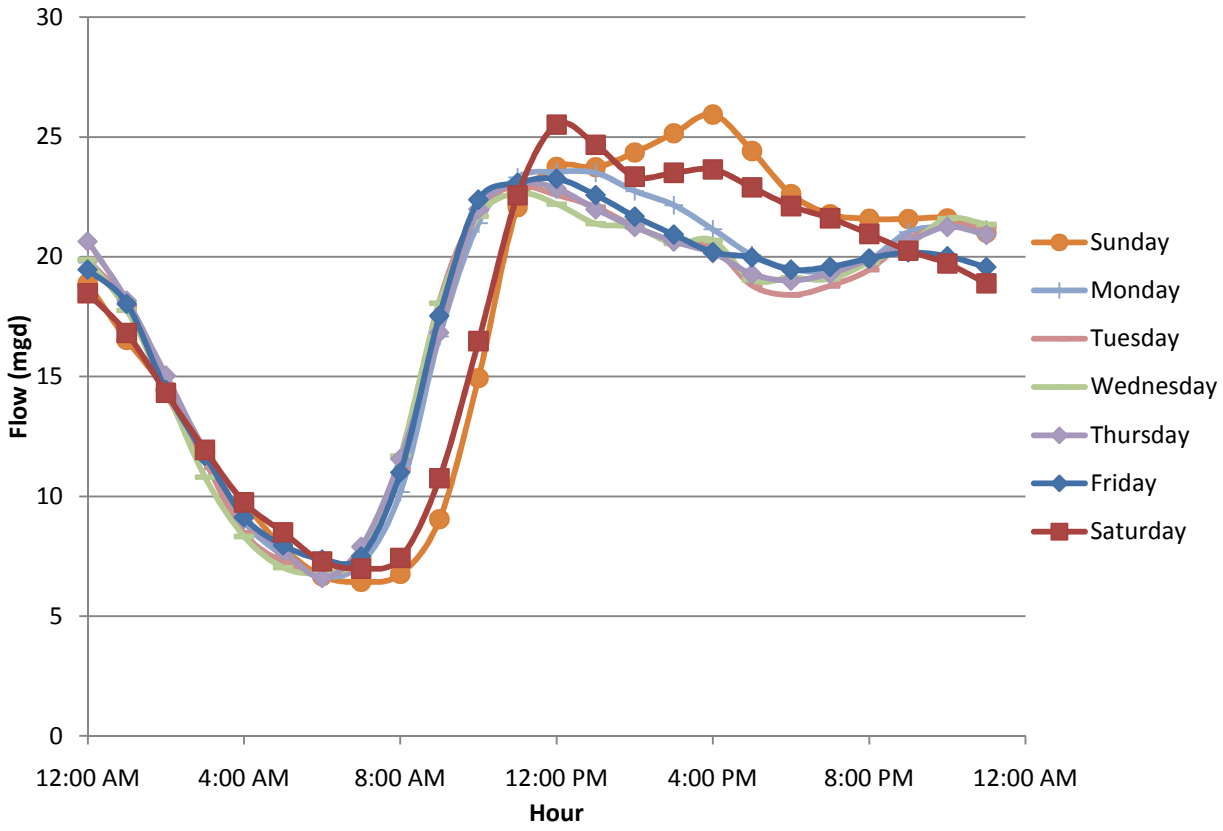


Figure 3-3
Average Hourly Filter Effluent Flows by Day of Week, Long Beach WRP[1]

[1] The graph is plotted using data from February 2009 to February 2010.

Figure 3-4 below shows the graph of average hourly filter effluent flow by month. There are no substantial differences in flows from month to month.

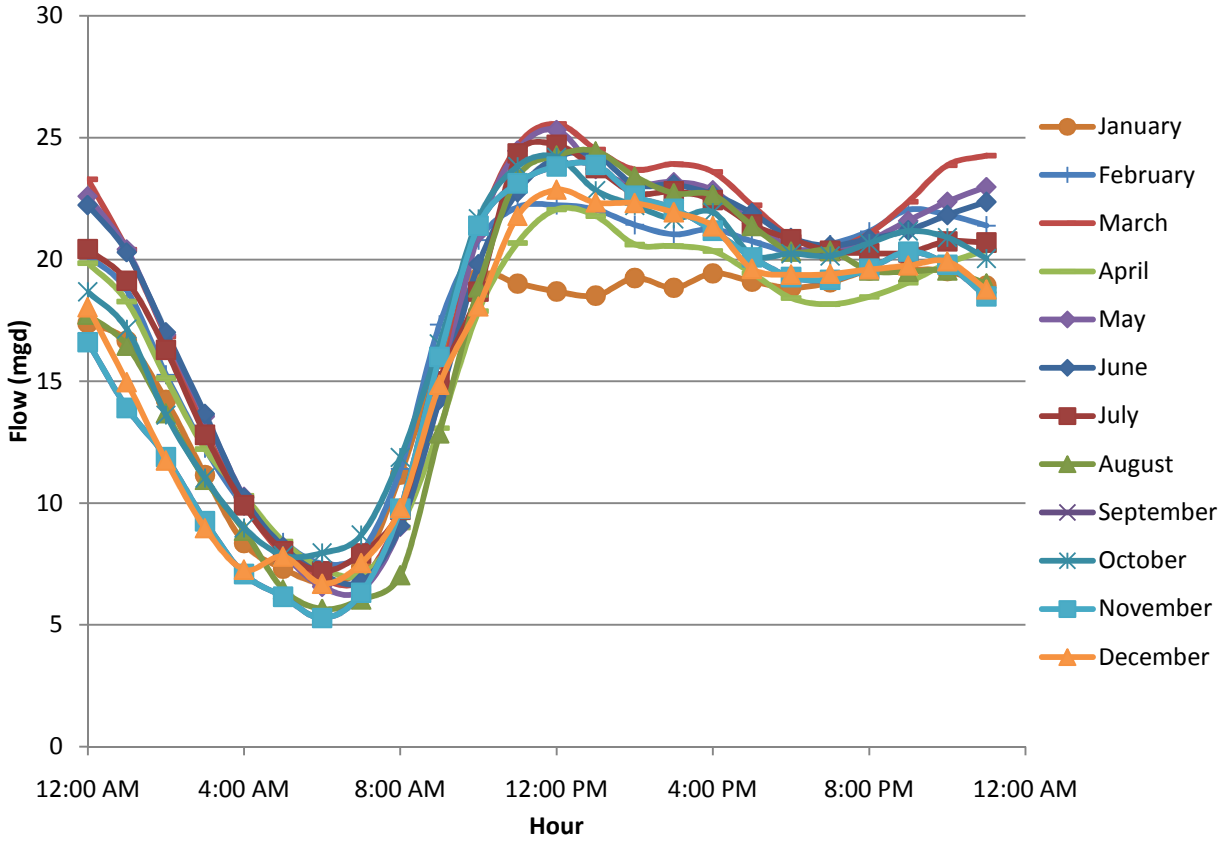


Figure 3-4
Average Hourly Filter Effluent Flows by Month, Long Beach WRP[1]

[1] The graph is plotted using data from February 2009 to February 2010.

3.5.2 Available Daily Supplies

Figure 3-5 shows the graph of average monthly filter effluent flows. The graph shows the bars for minimum and maximum daily flows for each month. The average monthly flow ranges from 15 mgd to 18 mgd. **Figure 3-6** shows the graph of average daily filter effluent flows.

During winter months, there are several days with high maximum flows due to wet weather events. There were also several low flow days in May 2009 and January 2010. It is understood that the days of low flows are due to modified LACSD system operation, leading to lower available flows.

Based on the filter effluent flow data, the average daily flow for filter effluent is 17.4 mgd. The supply graphs show that during the summer months (also when there is the highest recycled water demand), the lowest supplies occur in August. Over the summer period, the lowest daily flow for the filter effluent recorded is 15 mgd. The second lowest effluent flow is 15.4 mgd. Both the lowest and second lowest summer flow days occur on consecutive days in August. In order to eliminate potential anomalies in flow measurements, the second lowest daily flows

during the summer months, 15.4 mgd, will be used for further analysis and evaluation as the available supply from LACSD. Over the entire year, counting for maintenance and other events, this flow is available 92 percent of the time. The actual available supply shall be adjusted to account for the utility water demand (0.5 mgd) at the LBWRP. Thus, the available existing daily supply to LBWD that will be used in future evaluations is 14.9 mgd.

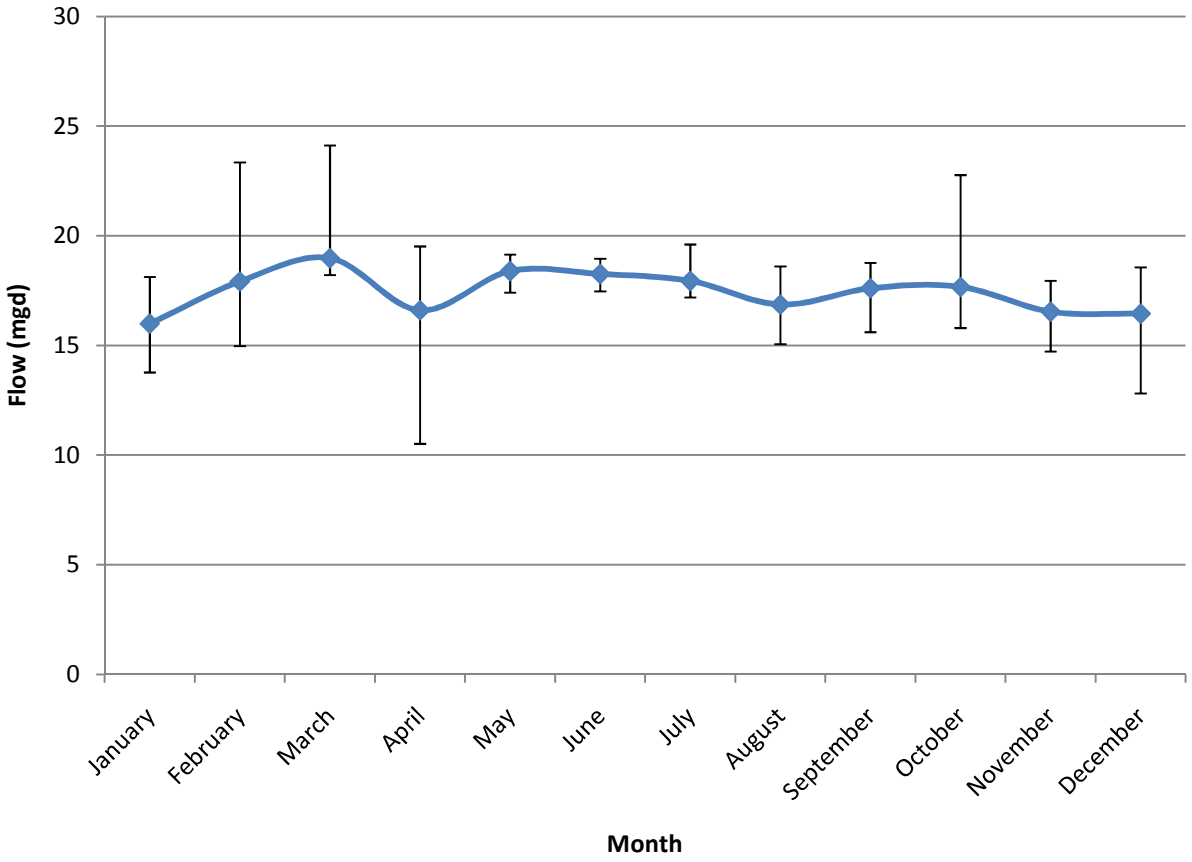


Figure 3-5
Average Monthly Filter Effluent Flows, Long Beach WRP[1]

[1] The graph is plotted using data from February 2009 to January 2010. Error bars depict maximum and minimum daily flows over the month.

3.5.3 Available Hourly Supplies

Since August is the lowest summer flow month, an average diurnal curve is developed for available supplies for the entire year and the month of August as shown in **Figure 3-7**. The August diurnal curve is then applied to the 15.4 mgd available from LACSD, and is adjusted for the expected utility water demand. **Figure 3-8** and shows the available flow on an hourly basis to LBWD.

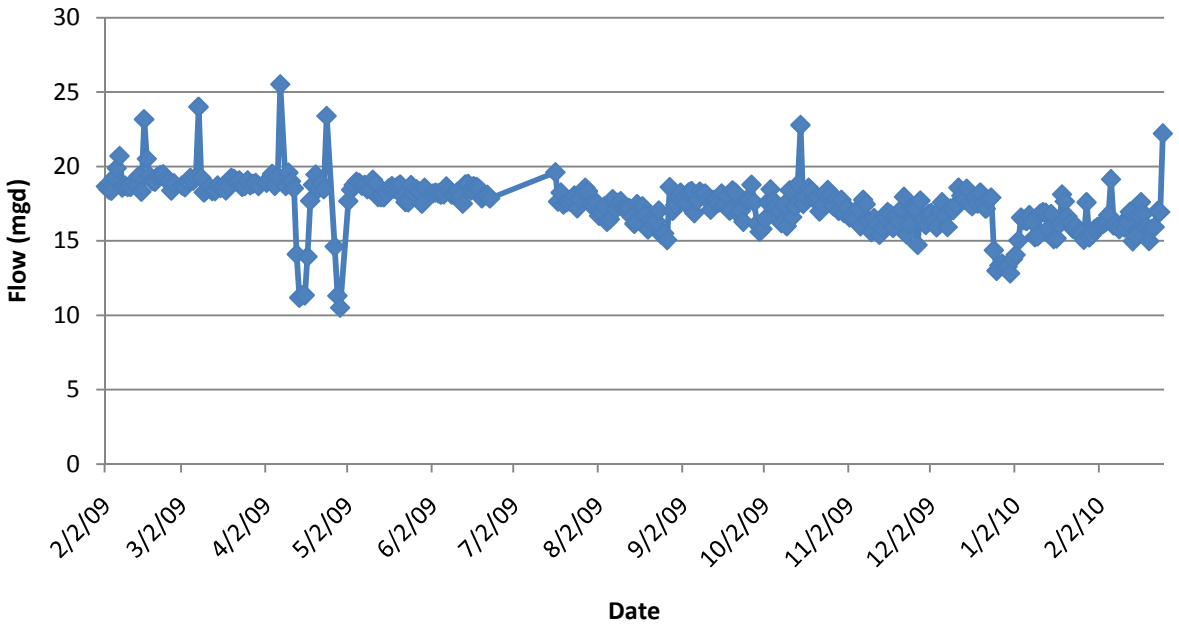


Figure 3-6
Average Daily Filter Effluent Flows, Long Beach WRP

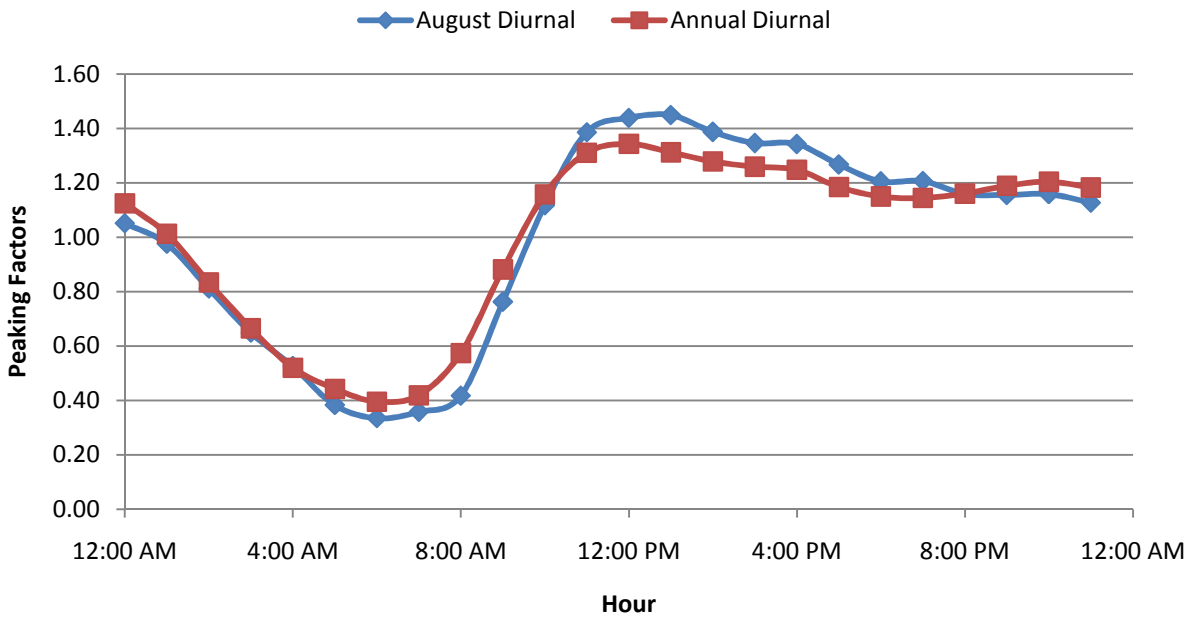


Figure 3-7
Annual and August 2009 Supply Diurnal Curve

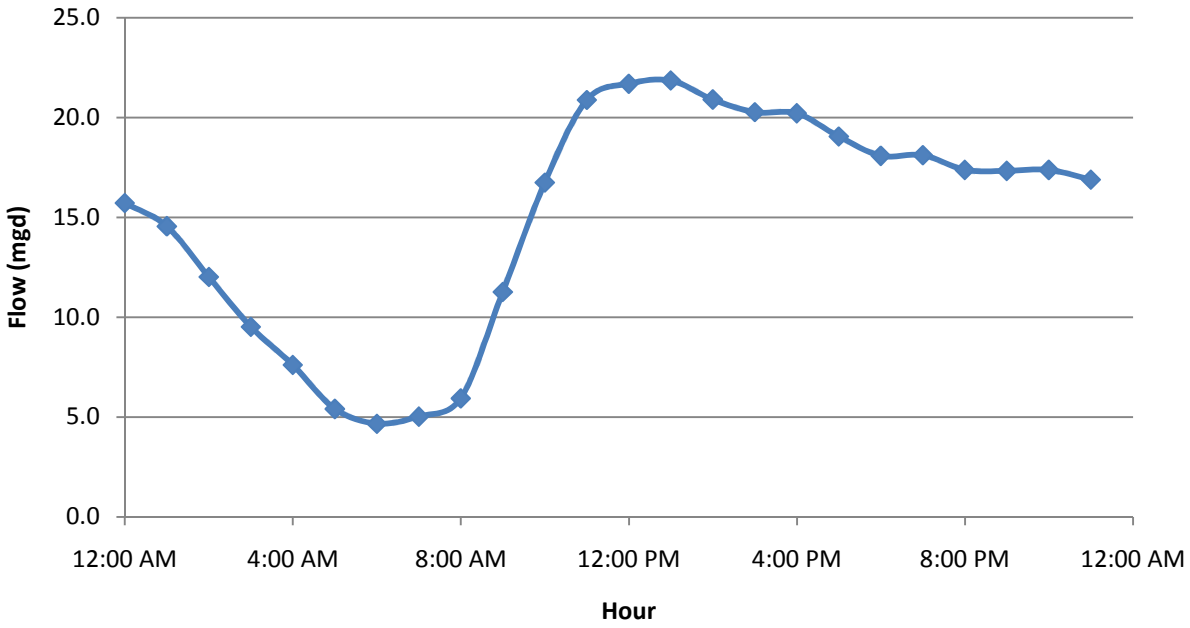


Figure 3-8
Available Flows from Long Beach WRP to LBWD

Table 3-2
Available Average Hourly Flows from LBWD to LBWD

Hour	Hourly Flows (mgd)
12:00 AM	16.2
1:00 AM	15.1
2:00 AM	12.5
3:00 AM	10.0
4:00 AM	8.1
5:00 AM	5.9
6:00 AM	5.2
7:00 AM	5.5
8:00 AM	6.4
9:00 AM	11.8
10:00 AM	17.2
11:00 AM	21.4
12:00 PM	22.2
1:00 PM	22.3
2:00 PM	21.4
3:00 PM	20.8
4:00 PM	20.7
5:00 PM	19.5
6:00 PM	18.6
7:00 PM	18.6
8:00 PM	17.9
9:00 PM	17.8
10:00 PM	17.9
11:00 PM	17.4

3.6 CONCLUSION

Average flows from LBWRP total 15.4 mgd, but accounting for variations in flow and LACSD's utility water demands, the minimum available daily flow from LACSD is equal to 14.9 mgd. This flow is available to LBWD 92 percent of the time. **Figure 3-8** and show the minimum available flow to LBWD on an hourly basis.

Section 4
Existing Recycled Water Customers

4.1 INTRODUCTION

This section presents a summary of the existing recycled water demands in Long Beach Water Department's (LBWD) service area. Based on the available consumption data (monthly billing records), historical water demands are grouped into eight categories and their usage and trends are evaluated. Peaking factors and diurnal curves are developed to evaluate the fluctuation in water demands on an hourly basis. A diurnal curve depicting demand variations over a maximum demand day (MDD) is also developed.

4.2 HISTORICAL AND EXISTING RECYCLED WATER DEMANDS

Currently, LBWD's recycled water system has 94 active connections serving primarily irrigation customers. An overview of LBWD's recycled water system infrastructure along with the service connections is provided on **Figure 4-1**. A review of the available billing data for the period from October 2004 to September 2009 indicates that recycled water is predominantly used for irrigation within LBWD's service area. These irrigation customers include schools, golf courses, cemeteries, country clubs, parks, and other miscellaneous irrigation customers within the service area. Other major customers include THUMS Long Beach Company (THUMS) and the Water Replenishment District of Southern California (WRD). THUMS uses recycled water for groundwater injection to repressurize offshore oil-bearing strata. WRD uses recycled water at the Leo VanderLans Water Treatment Facility as a barrier against seawater intrusion. **Table 4-1** summarizes the recycled water use in LBWD's service area over the past five years categorized by usage type. In this table, all irrigation customers are represented under a single category.

Table 4-1
Summary of Historical Recycled Water Usage in Acre-Feet/Year (by usage type)

Customer Type	2005	2006	2007	2008	2009
Irrigation	3,226	3,670	4,084	3,931	3,321
WRD	838	859	704	1,754	2,169
THUMS	1,044	1,243	1,438	1,165	889
Total	**5,109**	**5,772**	**6,226**	**6,850**	**6,379**

Note: Billing data provided by LBWD in fiscal year format. Data has been presented to reflect consumption by calendar year.

Irrigation demands exhibit significant variability with demands increasing from year 2005 to year 2007 and decreasing thereafter. Recycled water use at the Leo VanderLans Treatment Facility has almost tripled between year 2005 and year 2009. Recycled water use at THUMS accounts for approximately 15 percent to 25 percent of the total demand. As shown in **Table 4-1**, demands have steadily increased between year 2005 and 2009. The average daily demand (ADD) for year 2009 is approximately 4,000 gallons per minute (gpm) or 5.7 million gallons per day (mgd). The ADD values represent consumption data not adjusted for water loss.

Table 4-2 presents the recycled water use within various categories that constitute irrigation within LBWD's service area. As potable water customers such as parks and golf courses get converted to recycled water, a steady increase in recycled water use is observed for these categories over the past five years.

Table 4-2
Summary of Historical Recycled Water Usage in Acre-Feet/Year

Customer Type	2005	2006	2007	2008	2009
Cemetery	197	217	239	235	215
Country Clubs	723	739	862	818	411
Golf Courses	939	1,028	1,214	1,104	998
Miscellaneous Irrigation	184	230	261	226	212
Parks	980	1,223	1,249	1,308	1,218
Schools	203	233	260	240	268
WRD	838	859	704	1,754	2,169
THUMS	1,044	1,243	1,438	1,165	889
Total	**5,109**	**5,772**	**6,226**	**6,850**	**6,379**

Note: Billing data provided by LBWD in fiscal year format. Data has been presented to reflect consumption by calendar year.

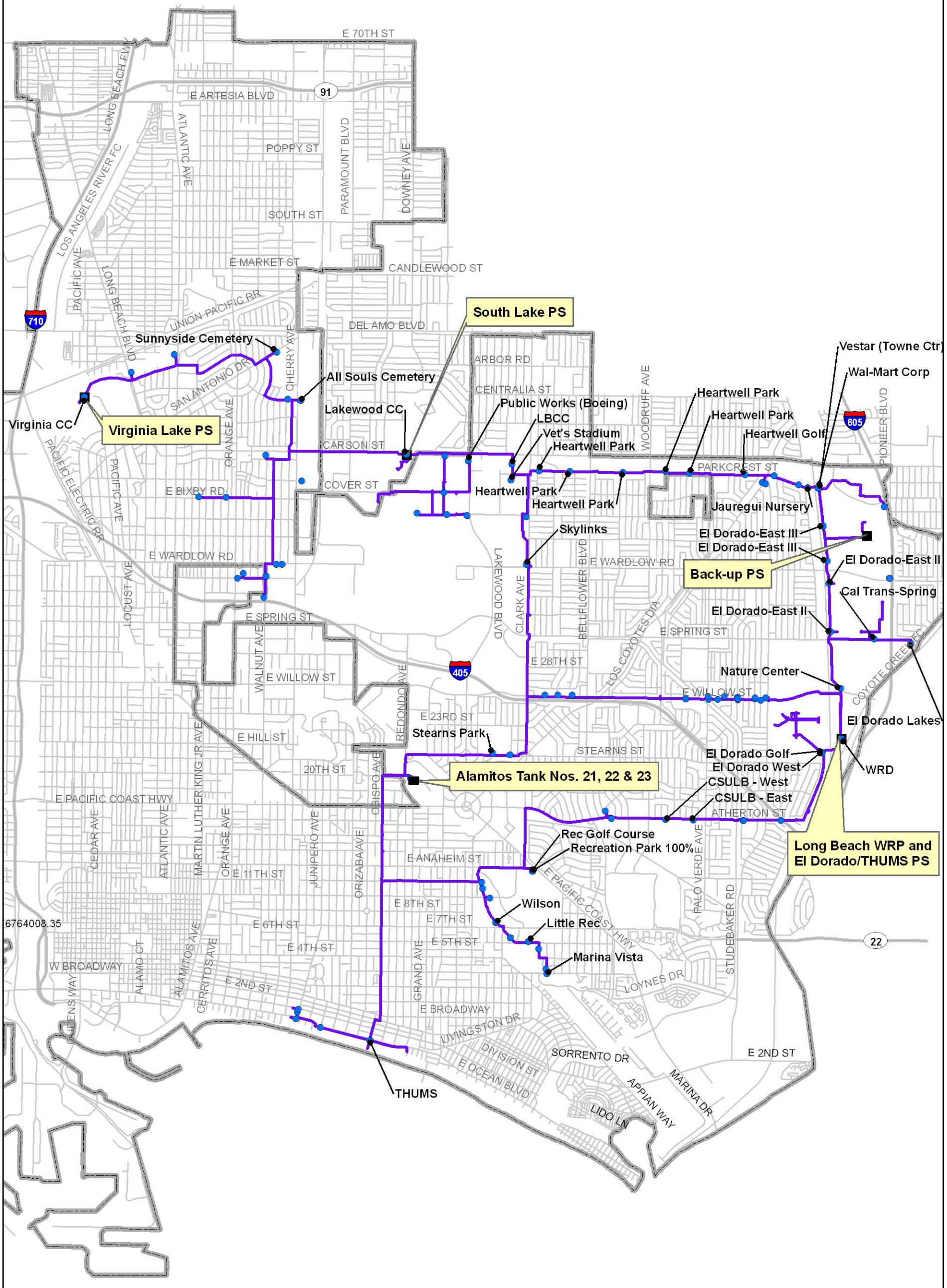
4.2.1 Unaccounted-for-Water

The difference between recycled water supply and demand (billed to customers) is defined as unaccounted-for water, or water loss. Unaccounted-for water may be attributed to leaking pipes, unmetered or unauthorized water use, inaccurate meters, or other events causing water to be withdrawn from the system and not measured.

Due to the uncertainty associated with the accuracy of the available flow data from LBWD and the Sanitation Districts of Los Angeles County (LACSD), computed demands based on recycled water supply sources, reservoir inflows, and reservoir outflows were compared with actual billing data. The difference between them is attributed to water loss. The overall annual average water loss for LBWD's recycled water system is eight percent and is within the standards for well operated systems (less than 10 percent water loss.)

4.2.2 Peaking Factors

ADD is typically assumed to be the baseline demand for computing peaking factors. The maximum day demand (MDD) peaking factor and peak hour demand (PHD) factors are used to



This map has been designed to print size 11'' by 17''.

scale up the ADD to estimate MDD and PHD. These estimated MDD and PHD are the demand conditions used to size recycled water distribution system pipelines and facilities.

Based on consumption (billing) data for existing recycled water customers, **Figure 4-2** shows the average monthly demand variation from 2004 to 2009. The maximum monthly demand (MMD) occurs during the month of August. The average consumption during this month is approximately 5,600 gpm or 8.0 mgd. The average annual consumption for year 2009 is approximately 3,600 gpm or 5.2 mgd. The ratio of MMD:ADD is 1.53. Since these values are computed from consumption data, these values are not adjusted for water loss.

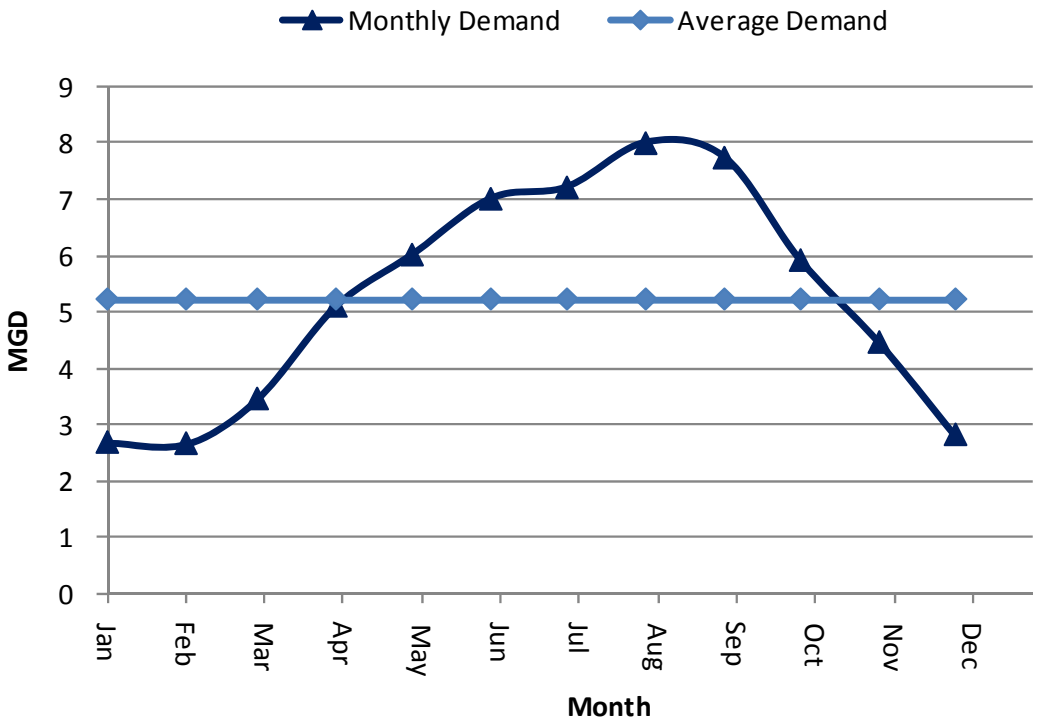


Figure 4-2
Average Monthly Demand from Billing Data (2004-2009)

Historical ratios for MMD to ADD for the different customer types are presented as peaking factors in **Table 4-3.** For the existing customer categories, no trends are observed in the MMD:ADD peaking factor values over time.

Table 4-3
Historical Peaking Factors (MMD:ADD)

Customer Type	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
Cemetery	2.29	2.30	1.63	2.03	1.91
Country Clubs	2.15	2.54	1.78	1.79	2.85
Golf Courses	2.16	2.38	1.68	1.90	2.04
WRD	3.42	1.64	2.04	2.30	1.83
Miscellaneous Irrigation	1.71	1.68	1.46	1.51	1.88
Parks	2.17	1.85	1.55	2.26	1.86
Schools	2.14	2.21	1.63	1.89	1.91
THUMS	1.41	1.96	1.80	1.70	2.01

Note: Billing data provided by LBWD in fiscal year format.

4.2.3 Daily Diurnal Curves

To determine the MDD and to establish PHD:MDD and MDD:MMD ratios, diurnal curves are developed for LBWD's recycled water system. Diurnal curves help better understand the demand fluctuations over the course of a 24-hour period. A diurnal curve represents the average hourly demand variation in a recycled water system. These curves are generated by developing an hourly mass balance for the recycled water system using recycled water inflows, reservoir outflows, and reservoir inflows. The computed hourly demand is represented as:

$$System\ Demand\ (or\ Outflow) = \Sigma Inflow - \Sigma Change\ in\ Storage$$

Inflow data are obtained from LBWD's North and South flow meters at the El Dorado Pump Station. Reservoir level data are obtained for LBWD's Tanks 21, 22, and 23. In addition, diurnal curves are also developed for different days of the week to identify water use patterns among the major water users.

Using this hourly demand methodology, demands for each month are shown in **Figure 4-3**. **Figure 4-4** presents the same demands computed on a hourly basis and summarized by week. This plot also shows a breakdown of the weekly demand by user types (THUMS, WRD, and existing irrigation customers). A review of this plot indicates greater variation among the irrigation demands over the year while demands at THUMS and WRD's LVL plant are fairly steady.

For year 2009, supplies to LBWD's recycled water system are lowest during the month of August. In addition, computed hourly recycled water demands are the highest during the month of August, with average demands of approximately 6,400 gpm or 9.2 mgd during the month of August. Therefore, August 2009 conditions are assumed to be representative of low supply and high demand conditions.

Figure 4-5 depicts the daily fluctuations in system demand during August 2009. As shown on **Figure 4-5**, demand variations occurring during early morning periods on Monday, Wednesday, and Friday are similar (and different from the remainder of the week) while demand variations occurring during late evening periods on Sunday, Tuesday, and Thursday are similar. This is due to the irrigation schedules for some of the large irrigation users.

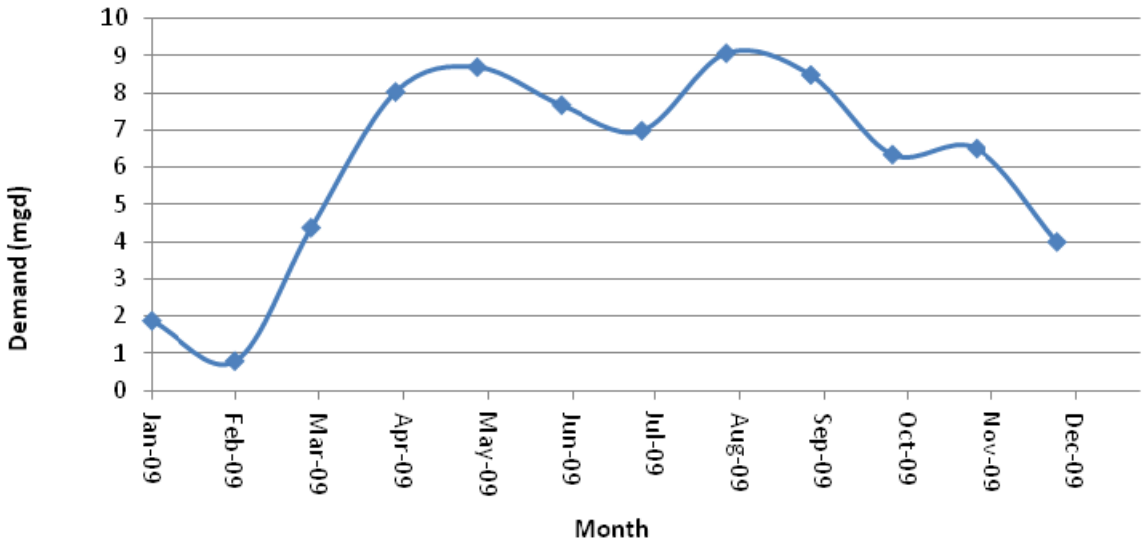


Figure 4-3
Monthly Demand from Hourly Flow Calculation (Year 2009)

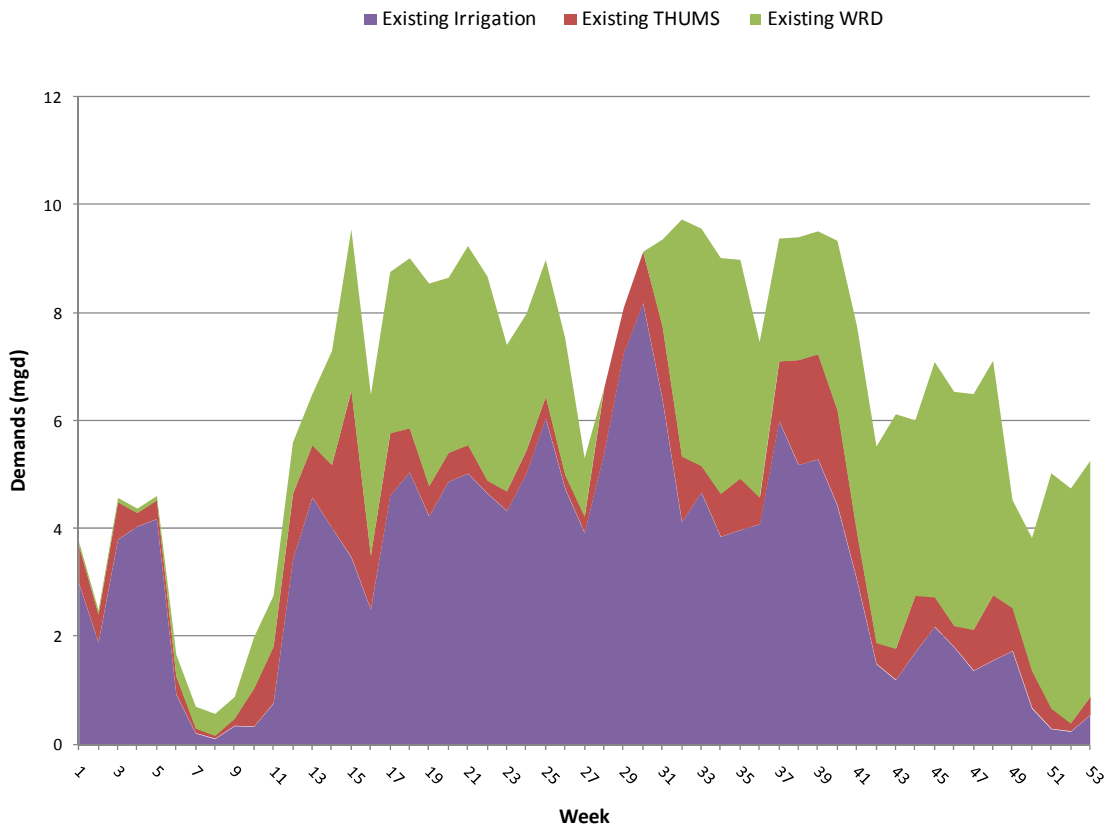


Figure 4-4
Weekly Demand from Hourly Flow Calculation (Year 2009)

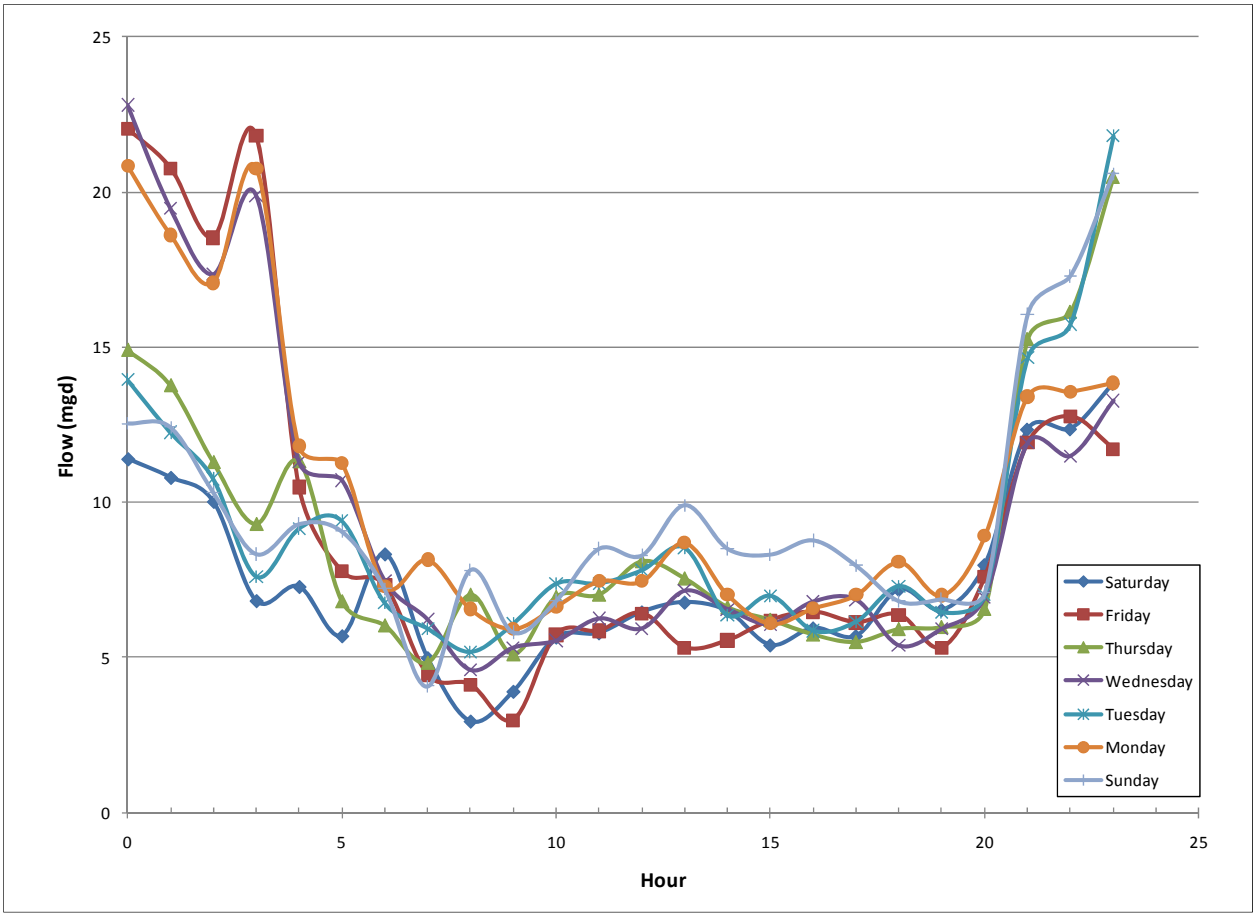


Figure 4-5
Average Demand by Day of Week (August 2009)

A review of the average hourly demands for each day of the week during August 2009 indicates that maximum system demand for a single 24 hour period occurs between 8:00 am on Sunday mornings and 8:00 am on Monday mornings. The average Sunday and Monday hourly values for August 2009 are assumed to be representative of maximum day demand conditions (MDD) and is shown on **Figure 4-6**. Based on average flows based on each day of the week, MDD conditions are estimated at 7,900 gpm or 11.4 mgd. The MDD:MMD ratio is 1.23.

The peak demand during a maximum day represents the peak hour demand factor. For LBWD's recycled water system, peak hour demand occurs at 3:00 am on a maximum demand day. The flow rate at peak hour demand conditions is approximately 14,500 gpm or 21 mgd.

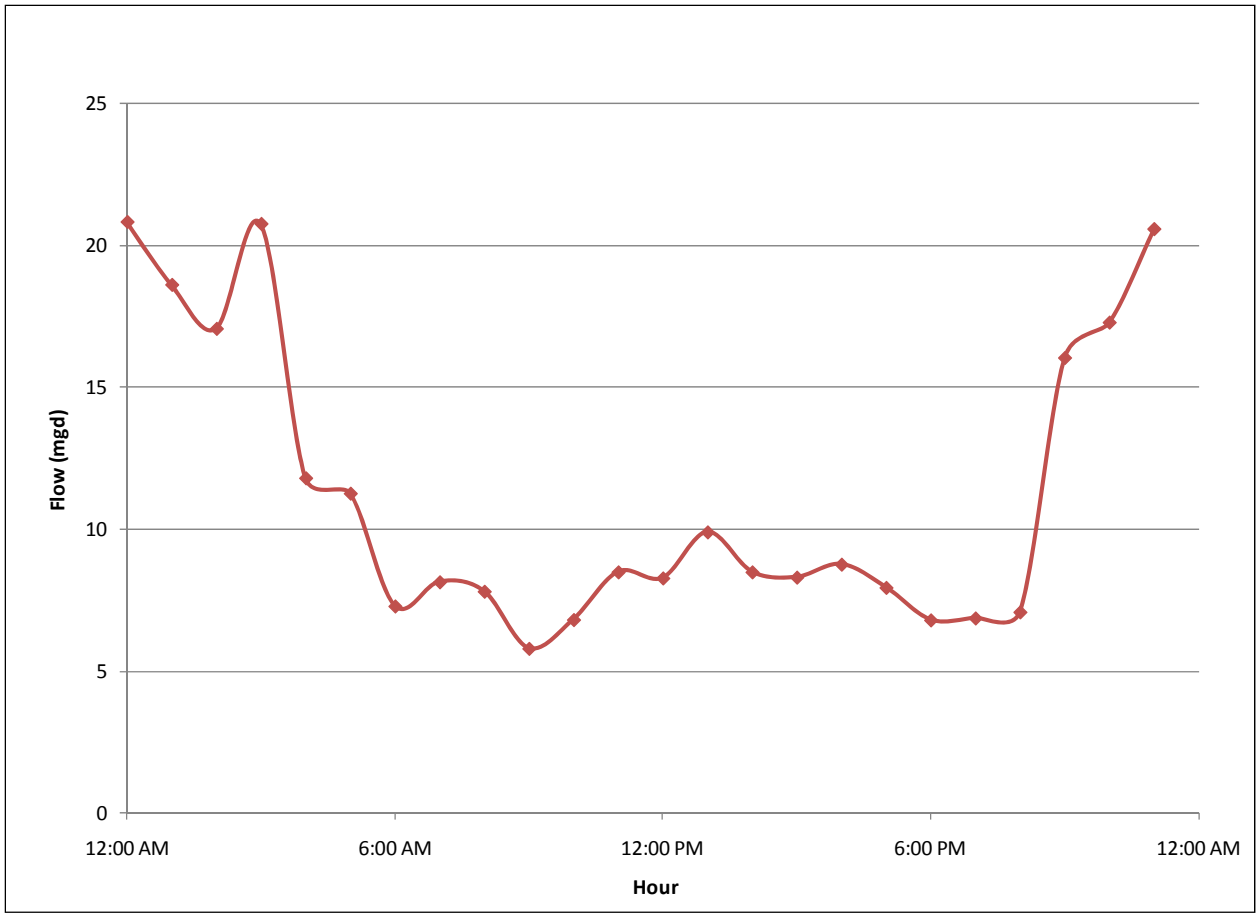


Figure 4-6
Maximum Day Demand Diurnal

4.2.4 Summary of Peaking Factors

The peaking factors discussed above are summarized in **Table 4-4**.

Table 4-4
Recommended Peaking Factors for System Evaluation and Sizing

Criteria	Peaking Factor
Peak Hour Demand: Maximum Day Demand (PHD:MDD)	1.84
Maximum Month Demand: Annual Average Demand (MMD:ADD)[1]	1.53
Maximum Day Demand: Annual Average Demand (MDD:ADD)	1.88
Peak Hour Demand: Annual Average Demand (PHD:ADD)	3.47

[1] MMD determined based on billing data provided by LBWD

All factors listed in **Table 4-4** (except for the MMD:ADD factor) are developed based on the hourly demand calculation described earlier. The system-wide MMD:ADD factor is developed based on year 2004 to 2009 billing data.

The peaking factors shown in **Table 4-4** are representative of system-wide demand variations and do not represent the demand variations for individual customers. Recycled water systems with predominantly irrigation customers tend to exhibit higher fluctuations in demand than systems with a mix of different customer types. It is observed that the usage patterns of the two large users, THUMS and WRD, dampen the overall demand fluctuations in the system. **Table 4-5** indicates peaking factors for LBWD's recycled water system (primarily irrigation customers) if demands from THUMS and WRD are excluded.

Table 4-5
Peaking Factors for Irrigation Customers

Criteria	Peaking Factor
Peak Hour Demand: Maximum Day Demand (PHD:MDD)	2.57
Maximum Month Demand: Annual Average Demand (MMD:ADD)	1.88
Maximum Day Demand: Annual Average Demand (MDD:ADD)	2.87
Peak Hour Demand: Annual Average Demand (PHD:ADD)	7.38

4.3 CONCLUSION

In conclusion, the diurnal curve developed for a 24-hour period in August 2009 shown in **Table 4-4** is representative of maximum demand conditions for LBWD's existing recycled water system. It is recommended that the peaking factors developed from this diurnal curve be used for system evaluation and the sizing of capital improvement facilities.

Section 5
Potential Future Recycled Water Customers

5.1 INTRODUCTION

This section presents a summary of the potential recycled water demands in Long Beach Water Department's (LBWD) service area. Analysis conducted for this section is based on available consumption data (monthly billing records) from LBWD's largest fifty (50) potable water customers, all potable irrigation customers, and customers that were identified in the 2003 Recycled Water Master Plan (RWMP). Only existing potable water customers having a demand greater than 20 acre-feet/year (acre-ft/yr) are considered as potential recycled water customers. Potential customers are identified by recycled water usage category, prioritized by average annual recycled water usage, and categorized by the likelihood of conversion from potable to recycled water. Peaking factors for recycled water usage by customer category and the peak hour demand for each customer are also discussed in this section.

5.2 EXPANSION OF EXISTING RECYCLED WATER CUSTOMERS

5.2.1 Water Replenishment District – Leo VanderLans Water Treatment Facility

The Water Replenishment District of Southern California (WRD) is one of LBWD's largest recycled water customers and uses recycled water at the Leo VanderLans Water Treatment Facility (LVL) for injection into their seawater intrusion well at the Alamitos Barrier. WRD has received Federal Stimulus Funding to complete a preliminary design for the expansion of the LVL. Currently, the water injected in the wells is a blend of 50 percent recycled water and 50 percent imported water. WRD is interested in injecting its barriers solely with recycled water, thereby increasing its recycled water demand from 3.9 million gallons per day (MGD) to 7.8 MGD, equating to a total demand of approximately 8,740 acre-ft/yr with a demand increase of 4,370 acre-ft/yr. Using a peaking factor of 1.0 for WRD as discussed on the next page, the future peak hour demand for WRD is approximately 5,417 gallons per minute (gpm).

5.2.2 THUMS Long Beach Company

THUMS Long Beach Company (THUMS) is currently LBWD's largest existing recycled water customer and uses recycled water for groundwater injection to re-pressurize offshore oil-bearing strata. THUMS will not be expanding its facilities, however, it is possible that THUMS may increase its recycled water demand in the future by replacing the potable water currently purchased from the Port of Long Beach (POLB). The site for an additional connection to THUMS is located at POLB's Pier J.

5.3 CONVERSION OF CUSTOMERS FROM POTABLE TO RECYCLED WATER

Forty-nine (49) LBWD and POLB customers have been identified as potential recycled water customers using more than 20 acre-ft/yr, as shown in **Table 5-2** and on **Figure 5-1**. These customers would be converted from potable to recycled water supplies. These customers include schools, golf courses, parks, power plants, oil refineries, hospitals, hotels, nurseries, commercial laundries and other industrial and residential customers, as summarized in **Table 5-1**.

Table 5-1
Summary of Potential Recycled Water Usage in Acre-Feet/Year
(By Customer Type)

Customer Type	Sum of Estimated RW Demand (acre-ft/yr)
Commercial Laundry	126
Golf	62
Hospital	152
Hotel	40
Industrial	797
Nursery	133
Oil	657
Park	185
Power	1,817
Residential	230
School	309
Total	**4,510***

Note: Estimated Recycled Water Demand is determined by the average water consumption from LBWD billing data multiplied by an assumed recycled water percent usage as shown in **Table 5-2**.
*Total recycled water demand rounded to the nearest ten.

5.3.1 Peaking Factors for Potential Recycled Water Customers

The term peaking factor used in this section is the ratio of peak hourly demand to average day demand (PHD:ADD). The peak hourly demand for each customer is shown in **Table 5-2**.

The peaking factor of customers using recycled water for irrigation is 7.4; this value is derived from water billing data analysis conducted in **Section 4** of this report. The peaking factor used for commercial laundries is 1.33, based on an 18 hours per day operation. The peaking factor used for industrial and oil refinery customers except THUMS is 2.0, based on a 12 hours per day operation. The peaking factor for THUMS oil refinery is 6.8, based on observed hourly data for the year 2009 of the neighboring THUMS facility. The power plant peaking factor of 4.0 is determined using historical data of a similar power plant in the Southern California area (MWH, 2007). The WRD peaking factor of 1.0 is also determined from hourly flow data for the month of August 2009.

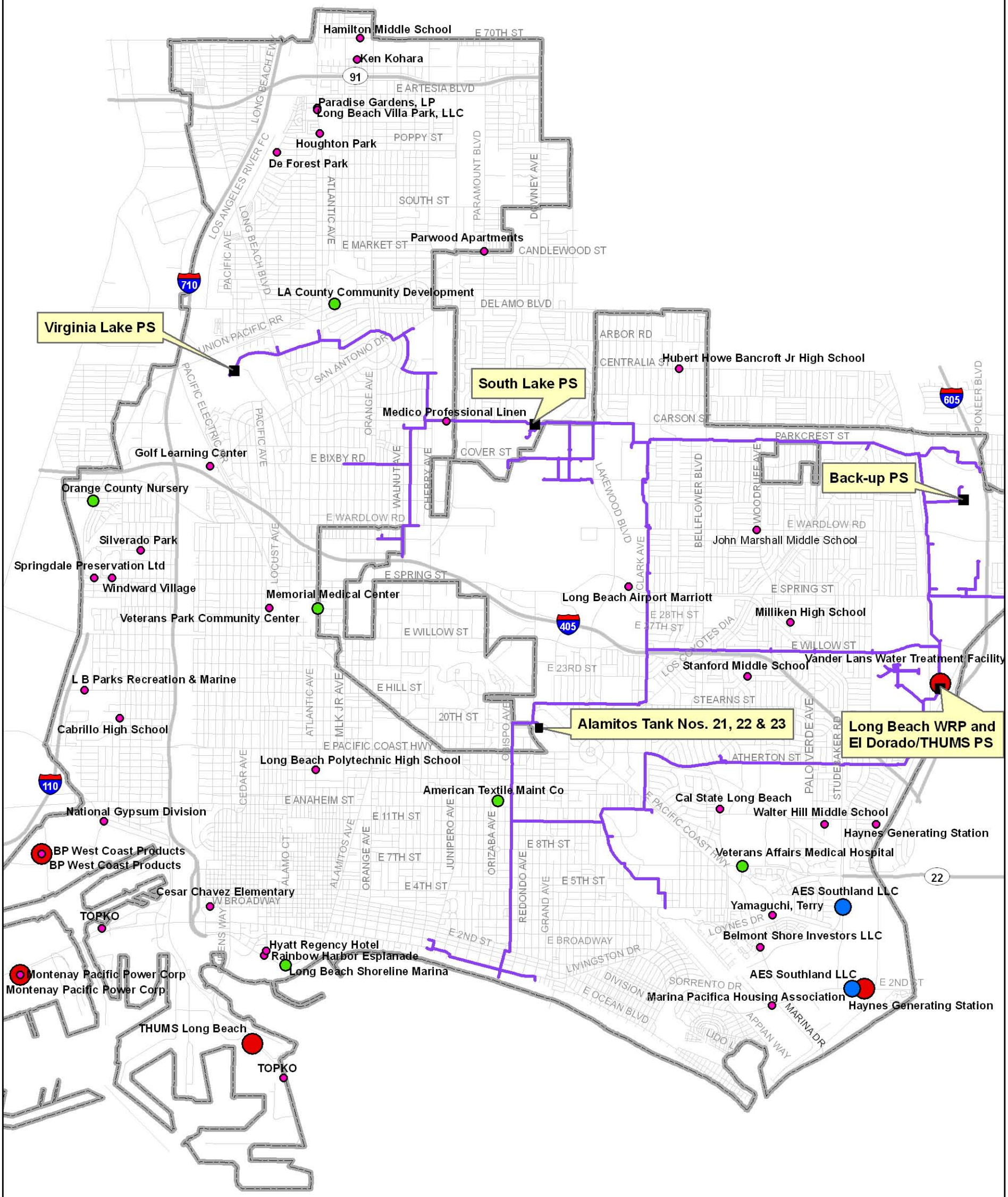


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Table 5-2
Potential LBWD Recycled Water Customers with Greater than 20 Acre-feet/year of Recycled Water Demand

No.	Owner	Name	Potential (Yes/No)	Usage Type	Category	Service Address	Estimated RW Usage (%)	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
1	BP West Coast Products	BP West Coast Products, Wilmington Calciner	No	Industrial	Industrial	1175 Carrack Ave	80%	728.8	451.8	2.0	903.7	Port of Long Beach Customer
2	THUMS Long Beach	THUMS Long Beach	Yes	Oil	Industrial	111 W. Ocean	100%	592.0	367.0	2.0	734.0	Port of Long Beach Customer
3	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	80%	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
4	L A Department Water & Power	Haynes Generating Station	Yes	Power	Industrial	6801 E 2nd St	80%	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
5	AES Southland LLC,	AES Southland LLC	No	Power	Industrial	500 Studebaker Rd	80%	183.7	113.9	4.0	455.5	Largest 50 Potable Customers
6	AES Southland LLC,	AES Southland LLC	No	Power	Industrial	6701 E 2nd St	80%	169.3	104.9	4.0	419.8	Largest 50 Potable Customers
7	American Textile Maint Company	American Textile Maintenance Co.	Yes	Commercial Laundry	Industrial	1340 Orizaba Ave	100%	102.3	63.4	1.3	84.6	Largest 50 Potable Customers
8	Memorial Medical Center	Memorial Medical Center	No	Hospital	Irrigation	2801 Atlantic Ave	30%	77.0	47.7	7.4	352.3	Largest 50 Potable Customers
9	U S Veterans Adm Hospital	Veterans Affairs Medical Hospital	No	Hospital	Irrigation	5901 E 7th St	30%	74.3	46.1	7.4	339.9	Largest 50 Potable Customers
10	Orange County Nursery Inc.	Orange County Nursery Inc.	No	Nursery	Irrigation	3400 Webster Ave	100%	68.1	42.2	7.4	311.6	2008-2009 Water Billing Data
11	L A County Community Develop	L A County Community Development	Yes	Residential	Irrigation	801 Via Carmelitos	30%	52.3	32.5	7.4	239.5	Largest 50 Potable Customers
12	Long Beach Parks Rec & Marine	Long Beach Shoreline Marina	Yes	Park	Irrigation	400 Shoreline Village Dr	100%	50.4	31.3	7.4	230.7	All Potable Irrigation Customers
13	Cal State University Long Beach	Cal State Long Beach	No	School	Irrigation	1250 Bellflower Blvd	30%	45.0	27.9	7.4	205.9	Largest 50 Potable Customers
14	Paradise Gardens LP	Paradise Gardens LP	No	Nursery	Irrigation	6479 Atlantic Ave	100%	43.8	27.2	7.4	200.4	Largest 50 Potable Customers
15	L A Department Water & Power	Haynes Generating Station	Yes	Power	Industrial	1116 Stevely Ave	80%	39.4	24.4	4.0	97.7	Largest 50 Potable Customers
16	L B Unified School District	Milliken High School	Yes	School	Irrigation	2800 Snowden Ave	100%	39.3	24.4	7.4	180.0	All Potable Irrigation Customers
17	Golf Learning Center	Golf Learning Center	No	Golf	Irrigation	3701 Pacific Pl	100%	38.0	23.5	7.4	173.7	2008-2009 Water Billing Data
18	BP West Coast Products	BP West Coast Products, Wilmington Calciner	No	Industrial	Industrial	1175 Carrack Ave	80%	37.6	23.3	2.0	46.6	Port of Long Beach Customer
19	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1277 S Harbor Scenic Dr	100%	36.0	22.3	2.0	44.6	Port of Long Beach Customer
20	City of Long Beach	Cesar Chavez Elementary	Yes	School	Irrigation	910 W Broadway	100%	34.7	21.5	7.4	158.6	All Potable Irrigation Customers
21	L B Unified School District	John Marshall Middle School	No	School	Irrigation	5870 E Wardlow Rd	100%	32.3	20.0	7.4	147.6	All Potable Irrigation Customers
22	National Gypsum Division	National Gypsum Division	No	Industrial	Industrial	1850 Pier B St	30%	30.5	18.9	2.0	37.8	Largest 50 Potable Customers
23	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	80%	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
24	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1755 Pier D Ave	100%	29.0	18.0	2.0	36.0	Port of Long Beach Customer
25	Windward Village	Windward Village	No	Residential	Irrigation	1831 W Spring St	30%	28.1	17.4	7.4	128.5	Largest 50 Potable Customers
26	Long Beach Villa Park, LLC	Long Beach Villa Park LLC	No	Residential	Irrigation	6475 Atlantic Ave	30%	27.4	17.0	7.4	125.3	Largest 50 Potable Customers
27	Marina Pacifica Housing Association	Marina Pacifica Housing Association	No	Residential	Irrigation	6201 E 2nd St	30%	27.1	16.8	7.4	124.2	Largest 50 Potable Customers
28	Cal State University Long Beach	Cal State Long Beach	No	School	Irrigation	1250 Bellflower Blvd	30%	27.0	16.8	7.4	123.6	Largest 50 Potable Customers
29	Springdale Preservation LTD	Springdale Preservation LTD	No	Residential	Irrigation	2095 W Spring St	30%	25.6	15.9	7.4	117.0	Largest 50 Potable Customers
30	L B Parks Bureau	De Forest Park	No	Park	Irrigation	6175 De Forest Ave	100%	25.4	15.7	7.4	116.2	All Potable Irrigation Customers
31	L B Unified School District	Stanford Middle School	No	School	Irrigation	5871 Los Arcos St	100%	24.2	15.0	7.4	110.7	All Potable Irrigation Customers
32	Belmont Shores Investors LLC	Belmont Shores Investors LLC	No	Residential	Irrigation	6261 E Pacific Coast Hwy	30%	23.9	14.8	7.4	109.2	Largest 50 Potable Customers
33	L B Unified School District	Hamilton Middle School	No	School	Irrigation	1060 E 70th St	100%	23.4	14.5	7.4	106.9	All Potable Irrigation Customers
34	Parwood Apartments	Parwood Apartments	No	Residential	Irrigation	5401 Paramount Blvd	30%	23.4	14.5	7.4	106.9	Largest 50 Potable Customers
35	L B Parks Bureau	Houghton Park	No	Park	Irrigation	6330 Atlantic Ave	100%	23.2	14.4	7.4	106.2	All Potable Irrigation Customers
36	Medico Professional Linen	Medico Professional Linen	Yes	Commercial Laundry	Irrigation	2201 E Carson St	30%	23.2	14.4	1.3	19.2	Largest 50 Potable Customers
37	Yamaguchi, Terry	Bixby Village Golf Course	No	Golf	Irrigation	6151 Bixby Village Dr	100%	23.1	14.3	7.4	105.6	All Potable Irrigation Customers
38	L B Marine Bureau	Rainbow Harbor Esplanade	Yes	Park	Irrigation	290 S Pine Ave	100%	22.5	14.0	7.4	103.0	All Potable Irrigation Customers
39	L B Parks Recreation & Marine	L B Parks Recreation & Marine	No	Park	Irrigation	2205 W Hill St	100%	21.7	13.5	7.4	99.4	All Potable Irrigation Customers
40	L B Unified School District	Long Beach Polytechnic High School	No	School	Irrigation	1600 Atlantic Ave	100%	21.6	13.4	7.4	98.9	All Potable Irrigation Customers
41	L B Parks Bureau	Silverado Park	No	Park	Irrigation	1516 W 32nd St	100%	21.5	13.4	7.4	98.6	All Potable Irrigation Customers
42	Parwood Apartments	Parwood Apartments	No	Residential	Irrigation	5401 Paramount Blvd	30%	21.5	13.4	7.4	98.5	Largest 50 Potable Customers
43	L B Unified School District	Hubert Howe Bancroft Junior High School	No	School	Irrigation	5301 Centralia St	100%	21.4	13.3	7.4	98.0	All Potable Irrigation Customers
44	Kohara, Ken	Kohara, Ken	No	Nursery	Irrigation	1065 Inez St	100%	20.5	12.7	7.4	93.8	All Potable Irrigation Customers
45	L B Unified School District	Walter Hill Middle School	Yes	School	Irrigation	1100 Iroquois Ave	100%	20.2	12.6	7.4	92.6	All Potable Irrigation Customers
46	Hyatt Regency Hotel	Hyatt Regency Hotel	Yes	Hotel	Irrigation	200 S Pine Ave	30%	20.0	12.4	7.4	91.4	Largest 50 Potable Customers
47	L B Unified School District	Cabrillo High School	No	School	Irrigation	2001 Santa Fe Ave	30%	19.7	12.2	7.4	90.1	Largest 50 Potable Customers
48	L B Parks Bureau	Veterans Park Community Center	No	Park	Irrigation	101 E 28th St	100%	19.5	12.1	7.4	89.3	All Potable Irrigation Customers
49	Long Beach Airport Marriott	Long Beach Airport Marriott	Yes	Hotel	Irrigation	4700 Airport Plaza Dr	30%	19.5	12.1	7.4	89.2	Largest 50 Potable Customers
							TOTAL	**4,510**	**2,800**		**11,480**	

Note: 1) Total demands rounded to the nearest ten.
2) Port of Long Beach Customer potable water use demand based on 2003 – 2007 average water consumption billing data .
3) Customers from the "All Potable Irrigation Customers" database have an assumed recycled water demand of 100-percent of its irrigation demand.
4) Assumed RW Usage Percentage (%) is determined by recycled water usage type.

A brief description of some of the potential recycled water customers is presented in the following paragraphs.

Commercial Laundries

American Textile Maintenance Company and Medico Professional Linen are commercial laundries identified as two potential recycled water customers with an estimated total demand of 126 acre-ft/yr. Both laundries are operated by the same parent corporation and have expressed interest regarding the potential use of recycled water in their facilities. The laundries use water to wash professional uniforms and hotel and motel linens in bulk through a large tunnel washer. The laundries have water softening facilities to treat for hardness.

Golf Courses

The Golf Learning Center and Bixby Village Golf Course are identified as potential recycled water customers with an estimated total demand of 62 acre-ft/yr. It is assumed that the recycled water demand for these courses will be the same as their current potable water use for irrigation. Previous studies investigating the recycled water conversion of the Bixby Village Golf Course indicate the presence of hydrocarbon pools along potential pipeline alignments to serve the golf course.

Hospital

The Memorial Medical Center and United Sates Veterans Affairs (VA) Medical Hospital are identified as potential recycled water customer. Recycled water will be used for irrigation at the hospitals with an estimated demand of 152 acre-ft/yr, which is approximately 30 percent of its current total potable water demand. Previous studies investigating the recycled water conversion of the VA Medical Hospital indicate that the hospital has concerns of Legionnaire's disease from the use of recycled water.

Hotel

The Hyatt Regency Hotel and Long Beach Airport Marriott are identified as hotels with a potential estimated recycled water demand of 40 acre-ft/yr for irrigation, which is approximately 30 percent of their current total potable water demand.

Industrial

The National Gypsum Division and BP West Coast Products, Wilmington Calciner are identified as industrial customers with a potential for using approximately 797 acre-ft/yr of recycled water. It is assumed that a minimum of 30-percent of the potable water use will be offset by recycled water. The BP West Coast Products, Wilmington Calciner facility is currently a Port of Long Beach customer. This facility generates coke from liquid petroleum wastes using heat and air flow. It is assumed that the facility mainly uses water for cooling towers and boilers. Recycled water used for cooling towers will have to be stripped of ammonia before use. Recycled water used for industrial boilers will require reduction in hardness, and is typically treated by microfiltration/reverse-osmosis (MF/RO) prior to boiler use.

National Gypsum Division is currently a Port of Long Beach customer, which manufactures building products, primarily gypsum wall board. Based on information available on US Gypsum Company, a similar manufacturing facility using recycled water in Central Basin Municipal Water District's service area, it is assumed that recycled water will be used for the paper pulp production process.

Nursery

Three (3) nurseries are identified as potential recycled water customers with an estimated total demand of 133 acre-ft/yr. It is assumed that 100-percent of potable water used for irrigation at nurseries will be substituted by recycled water with a peaking factor of 7.4. The owners and nurseries include the Orange County Nursery Inc., Paradise Gardens LP, and Ken Kohara.

Oil

In addition to THUMS, Tidelands Oil Production Company (TOPKO) is identified as a potential industrial recycled water user with a recycled water demand of approximately 657 acre-ft/yr. Like THUMS, TOPKO uses recycled water for oil well injection in the ocean to replace the oil that is pumped out of the ground and reduce the risk of land subsidence due to oil extraction operations. Both oil companies are currently Port of Long Beach Customers. It is assumed that 100-percent of the potable water will be replaced with recycled water.

Park

Seven (7) large parks are identified as potential recycled water customers with an estimated total demand of 185 acre-ft/yr. These parks are Long Beach Shoreline Marina, De Forest Park, Houghton Park, Rainbow Harbor Esplanade, Silverado Park, Veterans Park Community Center, and Long Beach Parks Recreation & Marine Park. It is assumed that 100-percent of potable water used for irrigation at park will be substituted by recycled water. There may be other parks as potential recycled water customers whose annual consumption is less than 20 acre-ft.

Power

Three (3) power companies are identified as potential recycled water customers with an estimated total demand of 1,817 acre-ft/yr. Power companies will be using recycled water for its industrial processes such as boilers, Nitrogen Oxide (NOx), injection, and inlet cooling within the plants. These companies are located on opposite ends of LBWD's service area. Haynes Generating Station and AES Southland LLC are located at the southeast corner of the LBWD's service area. There are two AES Southland LLC sites with a combined estimated recycled demand of 180 acre-ft/year. The Los Angeles Department of Water and Power owns the Haynes Generating Station (with two existing potable service connections). The Haynes Generating Station has an existing potable water demand of 420 acre-ft/year based on the 2009 year consumption data, and LADWP plans to expand this site to use up to 1,000 acre-ft/year of recycled water.

Montenay Pacific Power Corporation is located at the southwest corner of the LBWD's service area with approximately 420 acre-ft/yr of recycled water demand. The Montenay Pacific Power Corporation customer is the Montenay Pacific Waste Incineration Facility, which is a "solid

waste to energy" facility owned jointly by the City of Long Beach and Los Angeles County Sanitation Districts, and operated by Montenay Pacific Power. Residential and commercial solid waste is combusted in high temperatures in boilers to produce steam, which in turn is used to run the turbine-generator producing electricity. Montenay Pacific is currently a Port of Long Beach customer.

Residential

Seven (7) large residential customers have been identified as potential recycled water customers with a demand of 230 acre-ft/yr. Recycled water demand for residential customers is assumed to be 30-percent of its current potable water demand. Residential customers will use recycled water for irrigation. These residential customers are Los Angeles County Community Development, Windward Village, Long Beach Villa Park LLC, Marina Pacifica Housing Association, Springdale Preservation LTD, Belmont Shores Investors LLC, and Parwood Apartments.

Schools

Ten (10) schools have been identified as potential recycled water customers in the LBWD service area with an estimated demand of 309 acre-ft/yr. Two meters are located at the California State University, Long Beach south of the storm channel that runs west to east through the campus. Other schools include one elementary (Cesar Chavez), five (5) junior high and middle schools (John Marshall, Stanford, Hamilton, Walter Hill, Hubert Howe Bancroft), and three (3) high schools (Milliken, Cabrillo, Long Beach Polytechnic). Schools will use recycled water for irrigation. There may be other schools as potential customers that use less than 20 acre-ft/yr.

Previous studies investigating the conversion of Cal State Long Beach to recycled water indicate the presence of hydrocarbon pools along the proposed pipeline alignments that may cause problems during construction.

5.4 OTHER POTENTIAL RECYCLED WATER DEMANDS

Neighboring Cities

The City of Signal Hill is interested in receiving recycled water from LBWD to serve customers within their service area. The City of Signal Hill has estimated their recycled water demand to be approximately 404 acre-ft/yr as shown in **Appendix D**. By serving the City of Signal Hill, LBWD would also be able to deliver recycled water to LBWD customers located further away from the existing recycled system that may not be feasible to reach without having to cross the City of Signal Hill. These additional customers would be Chittick Field Park, Long Beach City College, Martin Luther King Jr. Park, and the proposed park in California Bowl.

The City of Lakewood has an existing recycled water system and is interested in serving additional customers with recycled water. The estimated additional recycled water demand of 150 acre-ft/yr is shown in **Appendix E**. Customers with a recycled water demand greater or equal to 20 acre-ft/year include Bolivar Park, Lakewood Elementary, Hoover Junior High School and are shown in **Figure 6-2**.

Other neighboring cities that may be interested in receiving recycled water from LBWD include the Cities of Seal Beach and Paramount. The potential recycled water demand for these cities needs to be further investigated.

5.5 SUMMARY

The potential recycled water customers that are identified within the LBWD service area include:

- WRD's VanderLans Advanced Water Treatment Facility Expansion (4,145 acre-ft/yr)
- Forty-nine (49) LBWD and POLB customers with industrial and irrigation uses (4,510 acre-ft/yr)
- Other neighboring cities (need further investigation to estimate demands)

Section 6
Alternative Development and Evaluation

6.1 INTRODUCTION

This section presents LBWD's recycled water pipelines, the results of the hydraulic analysis of LBWD's recycled water system under existing demand conditions, the approach used for developing pipeline alternatives to serve potential recycled water customers and prioritization.

6.2 PLANNING CRITERIA

The design criteria utilized for the pipeline sizing are summarized in **Table 6-1**.

Table 6-1
Pipeline Sizing and Evaluation Criteria

Item	Criteria
Pipeline Sizing Conditions	PHD – for pipelines where irrigation demands govern
Maximum Pipeline Velocity	6 ft/sec under PHD conditions
Headloss	< 6 ft/1,000 feet preferred under PHD conditions Headloss by itself does not govern pipeline sizing, but is used as sizing indicator. Pressure and velocity govern pipeline sizing
Friction Factor	Hazen-Williams C value of 115 for 12-inch diameter or less Hazen-Williams C value of 130 for pipes greater than 12-inch in diameter
Maximum Pressure	250 psi 150 psi (preferred)
Delivery Pressure Maximum Minimum	 150 psi, where possible 40 psi, where possible

6.2.1 Pipeline Sizing

As shown in **Table 6-1**, pipeline sizing is based on a combination of several factors:

- Demand conditions
- Pipeline velocity
- Pipeline headloss
- System pressures

Pipeline sizes are governed by PHD conditions due to the effect of night time demand for irrigation. Peaking factors used to calculate various demand conditions are discussed in **Section 5**. Pipelines are sized based on a maximum velocity of 6 ft/sec, which can occur during PHD conditions. When a pipeline velocity exceeds the velocity criterion under the governing demand

condition, the pipeline segment is upsized to the next standard size. Pipeline diameters used are 4-inch, 6-inch, 8-inch, 12-inch, 16-inch, 18-inch, and 20-inch.

Similar to pipeline velocity, headloss by itself does not govern pipeline sizing, but it is used as a sizing indicator. Pressure governs pipeline sizing. However, a maximum headloss of 6 ft/1,000 feet is preferred under PHD conditions.

The minimum system pressures for irrigation and industrial customers is 40 psi, however, in some cases, it will not be possible to deliver a minimum of 40 psi without extensive additional infrastructure. In cases where pressures will be less than 40 psi, a booster pump will be required at the customer's service connection. It is recommended that pipeline pressures do not exceed 150 psi where possible to avoid the need for high-pressure class piping and appurtenances.

6.2.2 Storage Capacity

Under existing conditions, only the top one-third of the storage reservoirs at the Alamitos site is used to meet operational requirements. To meet the increased water needs under future conditions, it is recommended that the top one-half of the storage reservoirs be used to meet operational storage. LBWD operations staff have indicated that during periods of very high demand, the storage reservoirs can drain over 10 feet in less than four hours. Utilizing only the top one-half of the storage reservoirs for operational requirements provides sufficient time to allow operators to implement back-up supply options such as utilizing potable water supply etc. during periods of very high demand.

6.3 EXISTING SYSTEM EVALUATION

System pressures for the existing recycled water distribution system are evaluated using the hydraulic model discussed in **Section 2**.

Under existing conditions without the South Lake Pump Station in operation, 13 out of 86 existing customers experience minimum pressures less than 40 psi. Minimum and maximum pressures range between 27 and 96 psi. Using the South Lake Pump Station in operation, only one of the existing customers experiences minimum pressures less than 40 psi; in this case the minimum and maximum pressures do not change. Without South Lake Pump Station operational, the majority of these low pressure sites are located in the northwest area of the LBWD recycled water system, west of the South lake Pump Station. With South Lake Pump Station operational, the only customer with low pressure below 40 psi is the Alamitos Reservoir-Irrigation at 27 psi. A list of minimum and maximum pressures for each service connection is provided in **Appendix F**. The minimum and maximum pressures for the existing system with South Lake pump station in operation are shown in **Figure 6-1**.

Pressures are slightly lower under existing conditions when the South Lake pump station is not in operation. LBWD currently does not operate the South Lake pump station under normal conditions, but it is recommended that LBWD consider using the South Lake pump station as a booster station to increase pressures at the northwest area of the service area during high demand conditions, especially if a demands are increased in the area either from existing customers or

potential customers. There will be additional costs associated with operating the South Lake pump station.

The top one-third of operational storage level is used at the Alamitos reservoirs under current operations. Under existing conditions, the tank level varies between 24 and 32 ft, as shown in **Figure 6-2**. Maximum velocities reach 8.5 fps, and the headlosses reach 10 ft/1,000 feet during peak hour.

6.4 ALTERNATIVE PIPELINE PROJECTS

Alternative pipeline projects have been developed to connect most of the potential recycled water customers, discussed in **Section 5**, to the recycled water system. The routing of the proposed pipelines are considered using a number of factors. In general, the alignment seeks to maximize the connections to significantly large-volume potential customers and terminate at the site of a major customer, generally a user with a minimum recycled water demand of 50 acre-ft/yr. Other factors considered for pipeline routing include ease of construction due to vehicle traffic, road conditions, crossing of freeways, railroad tracks, and flood control channels, as well as other factors.

Eleven (11) pipeline projects serving a variety of recycled water customers are developed and listed in **Table 6-2**. These projects include alternative pipeline segments that are connected to existing recycled water pipelines and shown in **Figure 6-3**. Each project is separated by industrial or irrigation recycled water usage. Several projects (i.e., Project No. 1, 7, 9, and 11) provide multiple pipeline routings to serve select large industrial customers. Several customers such as the Marina Pacific Housing Association, Parwood Apartments and Long Beach Polytechnic High School are located at such a long distance from an existing recycled water pipeline that it is currently not feasible to serve these customers. Medico Professional Linen is a potential customer with an estimated recycled water demand of 23.2 acre-ft/year, and is located on an existing LBWD recycled water pipeline alignment where a direct connection can be made to the recycled water system.

Project No.1 is located in the northwest area of the LBWD recycled water system and begins at the intersection of E 46th Street and Atlantic Avenue. Project No. 1A serves the Los Angeles County Community Development with 52.3 acre-ft/yr of recycled water demand. Project No. 1B is an extension to Project No. 1A and serves De Forest Park, Houghton Park, and Paradise Gardens LP, and Long Beach Villa Park LLC with a total recycled water demand of 119.8 acre-ft/yr. Project No. 1C is extended from Project 1B and serves a nursery owned by Ken Kohara and Hamilton Middle School, which have a total recycled water demand of 43.9 acre-ft/yr.

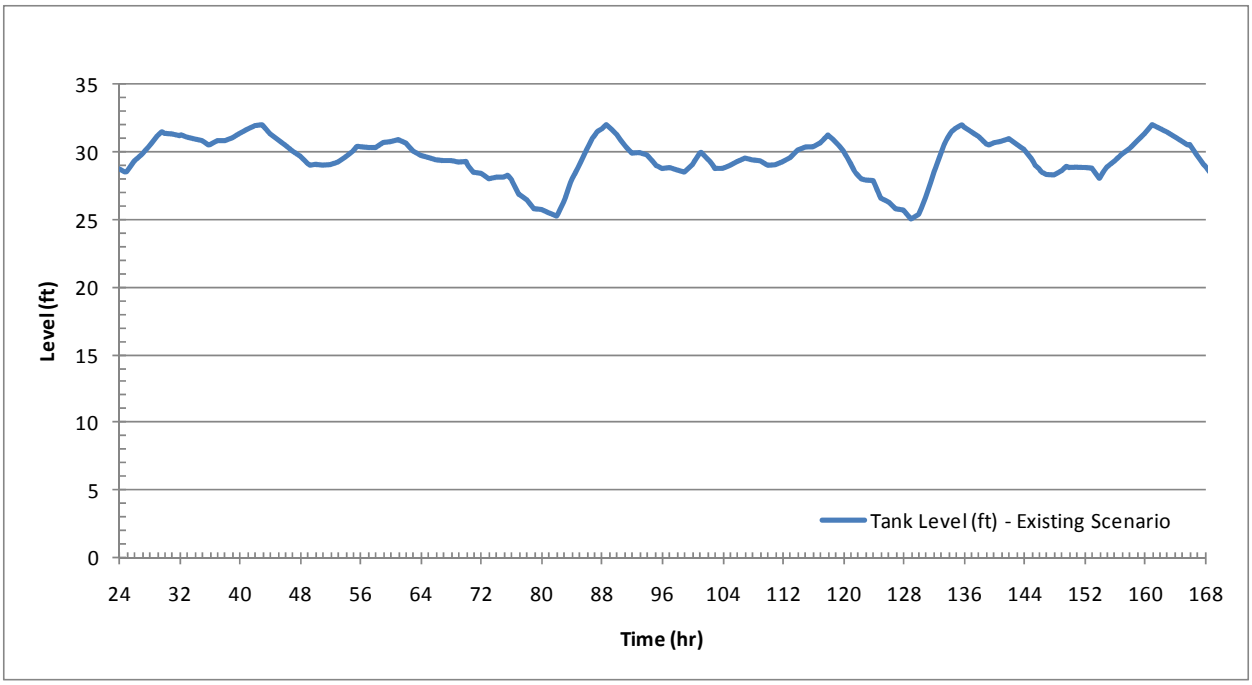


Figure 6-2
Alamitos Tank Levels Under Existing Conditions

Project No. 2 begins at Clark Avenue just north of E Lew Davis Street. The pipeline runs north on Clark Avenue and east on Centralia Avenue to serve Hubert Howe Bancroft Junior High School with an estimated recycled water demand of 21.4 acre-ft/yr.

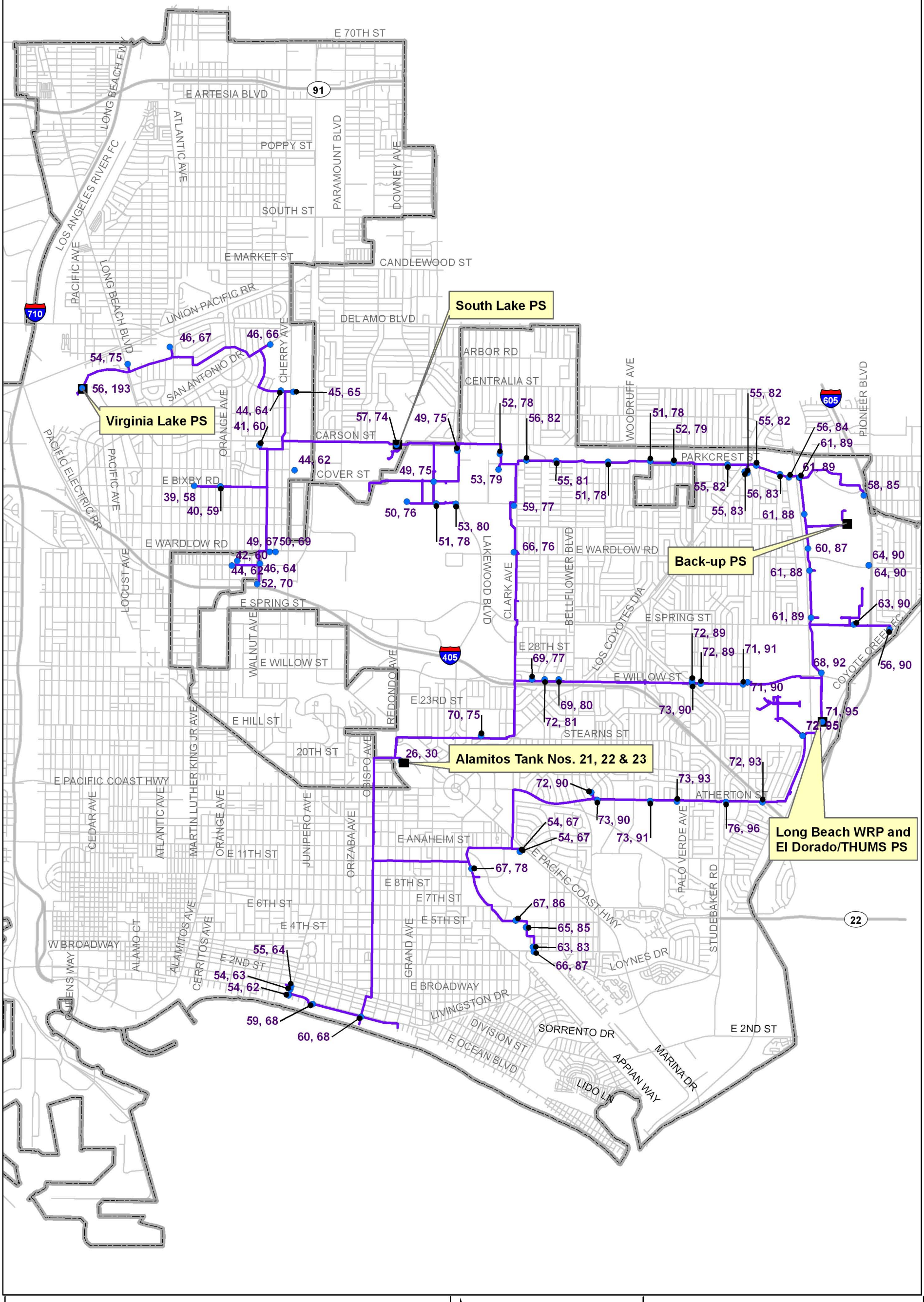
Project No. 3 begins the intersection of Parkcrest Street and Woodruff Avenue. The pipeline runs south on Woodruff Avenue to serve John Marshall Middle School with an estimated recycled water demand of 32.3 acre-ft/yr.

Project No. 4 begins at the intersection of E Willow Street and Palo Verde Avenue. The pipeline runs north on Palo Verde Avenue to serve Milliken High School with an estimated recycled water demand of 39.3 acre-ft/yr.

Project No. 5 begins at the intersection of E Willow Street and Woodruff Avenue. The pipeline runs south on Woodruff Avenue, crosses the 405-freeway, and heads west on E Los Arcos Street to serve Stanford Middle School with an estimated recycled water demand of 24.2 acre-ft/yr.

Project No. 6 begins at the intersection of E Spring Street and Clark Avenue. The pipeline runs west on E Spring Street to serve the Long Beach Airport Marriot with an estimated recycled water demand of 19.5 acre-ft/yr.

Project No. 7 is located in the southeast area of the LBWD recycled water system and provides three alternative pipeline routes (7A, 7B and 7C) to LADWP's Haynes Generating Station. Project No. 7A and 7B begins at the intersection of Vuelte Grande Avenue and E Atherton Street. The project No. 7A serves only the Haynes Generating Station with a recycled water



Key to Features

- Facilities
- City Boundary
- Freeway
- Street
- Recycled Water Main
- Existing Customer Pressures (min, max)

*Units of pressure in pounds per square inch (psi)

N

0 2,100 4,200 Feet

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Date: November 9, 2010

Existing Recycled Water System Pressures (Minimum & Maximum)

Figure 6-1

MWH

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Table 6-2
Potential Recycled Water Customers by Proposed Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
Project No. 1												
1A	11	L A County Community Develop	L A County Community Development	Yes	Residential	Irrigation	801 Via Carmelitos	52.3	32.5	7.4	239.5	Largest 50 Potable Customers
							Project 1A Total	52.3	32.5		239.5	
1B	14	Paradise Gardens LP	Paradise Gardens LP	No	Nursery	Irrigation	6479 Atlantic Ave	43.8	27.2	7.4	200.4	Largest 50 Potable Customers
1B	30	L B Parks Bureau	De Forest Park	No	Park	Irrigation	6175 De Forest Ave	25.4	15.7	7.4	116.2	All Potable Irrigation Customers
1B	35	L B Parks Bureau	Houghton Park	No	Park	Irrigation	6330 Atlantic Ave	23.2	14.4	7.4	106.2	All Potable Irrigation Customers
1B	26	Long Beach Villa Park, LLC	Long Beach Villa Park LLC	No	Residential	Irrigation	6475 Atlantic Ave	27.4	17.0	7.4	125.3	Largest 50 Potable Customers
							Project 1B Total	119.8	74.3		548.2	
1C	44	Kohara, Ken	Kohara, Ken	No	Nursery	Irrigation	1065 Inez St	20.5	12.7	7.4	93.8	All Potable Irrigation Customers
1C	33	L B Unified School District	Hamilton Middle School	No	School	Irrigation	1060 E 70th St	23.4	14.5	7.4	106.9	All Potable Irrigation Customers
							Project 1C Total	43.9	27.2		200.6	
							Project No. 1 Total	216.0	133.9		988.3	
Project No. 2												
2	43	L B Unified School District	Hubert How e Bancroft Junior High School	No	School	Irrigation	5301 Centralia St	21.4	13.3	7.4	98.0	All Potable Irrigation Customers
							Project No. 2 Total	21.4	13.3		98.0	
Project No. 3												
3	21	L B Unified School District	John Marshall Middle School	No	School	Irrigation	5870 E Wardlow Rd	32.3	20.0	7.4	147.6	All Potable Irrigation Customers
							Project No. 3 Total	32.3	20.0		147.6	
Project No. 4												
4	16	L B Unified School District	Milliken High School	Yes	School	Irrigation	2800 Snow den Ave	39.3	24.4	7.4	180.0	All Potable Irrigation Customers
							Project No. 4 Total	39.3	24.4		180.0	
Project No. 5												
5	31	L B Unified School District	Stanford Middle School	No	School	Irrigation	5871 Los Arcos St	24.2	15.0	7.4	110.7	All Potable Irrigation Customers
							Project No. 5 Total	24.2	15.0		110.7	
Project No. 6												
6	49	Long Beach Airport Marriott	Long Beach Airport Marriott	Yes	Hotel	Irrigation	4700 Airport Plaza Dr	19.5	12.1	7.4	89.2	Largest 50 Potable Customers
							Project No. 6 Total	19.5	12.1		89.2	
Project No. 7												
7A[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
							Project 7A Total	1000.0	620.0		2479.8	
7B[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
7B	5	AES Southland LLC,	AES Southland LLC	No	Pow er	Industrial	500 Studebaker Rd	183.7	113.9	4.0	455.5	Largest 50 Potable Customers
7B[1]	6	AES Southland LLC,	AES Southland LLC	No	Pow er	Industrial	6701 E 2nd St	169.3	104.9	4.0	419.8	Largest 50 Potable Customers
7B	15	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	1116 Stevely Ave	39.4	24.4	4.0	97.7	Largest 50 Potable Customers
							Project 7B Industrial Subtotal	1392.4	863.2		973.0	
7B	45	L B Unified School District	Walter Hill Middle School	Yes	School	Irrigation	1100 Iroquois Ave	20.2	12.6	7.4	92.6	All Potable Irrigation Customers
							Project 7B Irrigation Subtotal	20.2	12.6		92.6	
							Project 7B Total	1412.6	875.8		1065.7	

1 Customers on multiple proposed pipeline alignment options.

Table 6-2 (continued)
Potential Recycled Water Customers by Proposed Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
7C[1]	4	L A Department Water & Power	Haynes Generating Station	Yes	Power	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
7C[1]	6	AES Southland LLC,	AES Southland LLC	No	Power	Industrial	6701 E 2nd St	169.3	104.9	4.0	419.8	Largest 50 Potable Customers
							Project 7C Industrial Subtotal	1169.3	724.9			
7C	37	Yamaguchi, Terry	Bixby Village Golf Course	No	Golf	Irrigation	6151 Bixby Village Dr	23.1	14.3	7.4	105.6	All Potable Irrigation Customers
7C	9	U S Veterans Adm Hospital	Veterans Affairs Medical Hospital	No	Hospital	Irrigation	5901 E 7th St	74.3	46.1	7.4	339.9	Largest 50 Potable Customers
7C	32	Belmont Shores Investors LLC	Belmont Shores Investors LLC	No	Residential	Irrigation	6261 E Pacific Coast Hwy	23.9	14.8	7.4	109.2	Largest 50 Potable Customers
7C	13	Cal State University Long Beach	Cal State Long Beach	No	School	Irrigation	1250 Bellflower Blvd	45.0	27.9	7.4	205.9	Largest 50 Potable Customers
7C	28	Cal State University Long Beach	Cal State Long Beach	No	School	Irrigation	1250 Bellflower Blvd	27.0	16.8	7.4	123.6	Largest 50 Potable Customers
							Project 7C Irrigation Subtotal	193.3	119.8			
							Project 7C Total	1362.5	844.7		884.2	
							Project No. 7 Total	1605.9	995.6		3545.5	
Project No. 8												
8	7	American Textile Maint Company	American Textile Maintenance Co.	Yes	Commercial Laundry	Industrial	1340 Orizaba Ave	102.3	63.4	1.3	84.6	Largest 50 Potable Customers
							Project No. 8 Total	102.3	63.4		84.6	
Project No. 9												
9A	46	Hyatt Regency Hotel	Hyatt Regency Hotel	Yes	Hotel	Irrigation	200 S Pine Ave	20.0	12.4	7.4	91.4	Largest 50 Potable Customers
9A	12	Long Beach Parks Rec & Marine	Long Beach Shoreline Marina	Yes	Park	Irrigation	400 Shoreline Village Dr	50.4	31.3	7.4	230.7	All Potable Irrigation Customers
9A	38	L B Marine Bureau	Rainbow Harbor Esplanade	Yes	Park	Irrigation	290 S Pine Ave	22.5	14.0	7.4	103.0	All Potable Irrigation Customers
							Project 9A Total	92.9	57.6		425.1	
9B	24	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1755 Pier D Ave	29.0	18.0	2.0	36.0	Port of Long Beach Customer
9B[1]	3	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
9B[1]	23	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
							Project 9B Industrial Subtotal	453.1	280.9		1087.6	
9B	20	City of Long Beach	Cesar Chavez Elementary	Yes	School	Irrigation	910 W Broadway	34.7	21.5	7.4	158.6	All Potable Irrigation Customers
							Project 9B Irrigation Subtotal	34.7	21.5		158.6	
							Project 9B Total	487.7	302.4		1246.2	
9C[1]	1	BP West Coast Products	BP West Coast Products, Wilmington Calciner	No	Industrial	Industrial	1175 Carrack Ave	728.8	451.8	2.0	903.7	Port of Long Beach Customer
9C[1]	18	BP West Coast Products	BP West Coast Products, Wilmington Calciner	No	Industrial	Industrial	1175 Carrack Ave	37.6	23.3	2.0	46.6	Port of Long Beach Customer
9C[1]	22	National Gypsum Division	National Gypsum Division	No	Industrial	Industrial	1850 Pier B St	30.5	18.9	2.0	37.8	Largest 50 Potable Customers
							Project 9C Total	796.9	494.0		988.1	
9D	2	THUMS Long Beach	THUMS Long Beach	Yes	Oil	Industrial	1035 S Harbor Scenic Dr	592.0	367.0	2.0	734.0	Port of Long Beach Customer
9D	19	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1277 S Harbor Scenic Dr	36.0	22.3	2.0	44.6	Port of Long Beach Customer
							Project 9D Total	628.0	389.3		778.7	
							Project No. 9 Total	2005.5	1243.4		3438.0	
Project No. 10												
10 [1]	3	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
10 [1]	23	Montenay Pacific Power Corp	Montenay Pacific Power Corp	Yes	Power	Industrial	100 Henry Ford Ave	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
							Project No. 10 Total	424.1	262.9		1051.6	

1 Customers on multiple proposed pipeline alignment options.

Table 6-2 (continued)
Potential Recycled Water Customers by Proposed Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
Project No. 11												
11A	17	Golf Learning Center	Golf Learning Center	No	Golf	Irrigation	3701 Pacific Pl	38.0	23.5	7.4	173.7	2008-2009 Water Billing Data
11A	8	Memorial Medical Center	Memorial Medical Center	No	Hospital	Irrigation	2801 Atlantic Ave	77.0	47.7	7.4	352.3	Largest 50 Potable Customers
11A	48	L B Parks Bureau	Veterans Park Community Center	No	Park	Irrigation	101 E 28th St	19.5	12.1	7.4	89.3	All Potable Irrigation Customers
							Project 11A Total	134.5	83.4		615.3	
11B	10	Orange County Nursery Inc.	Orange County Nursery Inc.	No	Nursery	Irrigation	3400 Webster Ave	68.1	42.2	7.4	311.6	2008-2009 Water Billing Data
11B	39	L B Parks Recreation & Marine	L B Parks Recreation & Marine	No	Park	Irrigation	2205 W Hill St	21.7	13.5	7.4	99.4	All Potable Irrigation Customers
11B	41	L B Parks Bureau	Silverado Park	No	Park	Irrigation	1516 W 32nd St	21.5	13.4	7.4	98.6	All Potable Irrigation Customers
11B	25	Windw ard Village	Windw ard Village	No	Residential	Irrigation	1831 W Spring St	28.1	17.4	7.4	128.5	Largest 50 Potable Customers
11B	29	Springdale Preservation LTD	Springdale Preservation LTD	No	Residential	Irrigation	2095 W Spring St	25.6	15.9	7.4	117.0	Largest 50 Potable Customers
11B	47	L B Unified School District	Cabrillo High School	No	School	Irrigation	2001 Santa Fe Ave	19.7	12.2	7.4	90.1	Largest 50 Potable Customers
							Project 11B Total	184.7	114.5		845.1	
							Project No. 11 Total	319.2	197.9		1460.4	

Central Basin MWD Existing RW Pipeline
Los Coyotes WRP
Lakewood Existing RW Pipeline
Cerritos Existing RW Pipeline
West Basin MWD Existing RW Pipeline
Carson Regional WRP
Terminal Island Existing RW Pipeline
Harbor Generating Station
Terminal Island WRP
Hamilton Middle School
Ken Kohara
Project No. 1C
Paradise Gardens, LP
Long Beach Villa Park, LLC
Houghton Park
De Forest Park
Project No. 1B
LA County Community Development
Project No.1A
Virginia Lake PS
Golf Learning Center
Orange County Nursery
Project No. 11A
Silverado Park
Springdale Preservation Ltd
Windward Village
Veterans Park Community Center
Project No. 11B
L B Parks Recreation & Marine
Cabrillo High School
Long Beach Polytechnic High School
National Gypsum Division
BP West Coast Products
BP West Coast Products
Project No. 9C
Cesar Chavez Elementary
Project No. 9B
TOPKO
Montenay Pacific Power Corp
Montenay Pacific Power Corp
Project No. 9A
Hyatt Regency Hotel
Rainbow Harbor Esplanade
Long Beach Shoreline Marina
Project No. 9D
THUMS Long Beach
TOPKO
Parwood Apartments
Lakewood Elementary
Bolivar Park
Hoover Jr High School
Hubert Howe Bancroft Jr High School
South Lake PS
Medico Professional Linen
Project No. 2
Cal Trans
US Filter
Memorial Medical Center
P.S. Business Park
Costco
BP Oil Refinery
Alamitos Tank Nos. 21, 22 & 23
American Textile Maint Co
Project No. 8
Long Beach Airport Marriott
Project No. 6
Back-up PS
Project No. 3
John Marshall Middle School
Milliken High School
Project No. 4
Project No. 5
Stanford Middle School
Vander Lans Water Treatment Facility
Long Beach WRP and El Dorado/THUMS PS
Cal State Long Beach
Project Nos. 7A & 7B
Walter Hill Middle School
Haynes Generating Station
Veterans Affairs Medical Hospital
Project No. 7C
Bixby Village Golf Course
AES Southland LLC
Belmont Shore Investors LLC
AES Southland LLC
Haynes Generating Station
Marina Pacifica Housing Association

Notes:

Project 7A serves Haynes Generating Station on 2nd Street only.
Project 7B serves Haynes Generating (2), AES Southland LLC (2), and Walter Hill Middle School.
Project 7C serves all customers along alignment 7C including Haynes Generating Station and AES Southland LLC on 2nd Street.

Keys to Features

- Facilities
- City Boundary
- Freeway
- Street

Existing Pipeline

- City of Cerritos and Lakewood
- West Basin Municipal Water District
- Central Basin Municipal Water District
- Terminal Island
- Long Beach Water Department

Potential Recycled Water Customers

Demand

- < 19.5 AFY
- >= 19.5 - 50 AFY
- > 50 - 150 AFY
- > 150 - 300 AFY
- > 300 AFY

* Customer Name labeled for demands >= 19.5 AFY

N

0 2,200 4,400 Feet

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Date: August 6, 2010

Potential Recycled Water Customers and Pipeline Alignments

Long Beach Water Department

Figure 6-3

MWH

This map has been designed to print size 34" by 44".

demand of 1,000 acre-ft/yr, while Project 7B serves the Haynes Generating Station in addition to two AES Southland LLC sites, a second Haynes Generating Station site and Walter Hill Middle School with a total recycled water demand of 1,412.6 acre-ft/yr. Project No. 7C begins at the intersection of Merriam Way and Atherton Street. This project serves two Cal State Long Beach sites, Veterans Affairs Medical Hospital, Bixby Village Golf Course, Belmont Shores Investors LLC, and AES Southland LLC and Haynes Generating Station on E 2nd Street with a total recycled water demand of 1,362.5 acre-ft/yr.

Project No. 8 begins at the intersection of Obispo Avenue and E Anaheim Street. The pipeline runs west on E Anaheim Street and north on Orizaba Avenue to serve American Textile Maintenance Company with an estimated recycled water demand of 102.3 acre-ft/yr.

Project No. 9 is located in the southwest area of the LBWD recycled water system. Project No. 9A begins at the E 11th Street and Obispo Avenue intersection and extends west to serve Hyatt Regency Hotel, Rainbow Harbor Esplanade, Long Beach Shoreline Marina, and Cesar Chavez Elementary with a total recycled water demand of 92.9 acre-ft/yr. Project No. 9A ends at the intersection of Pico Avenue and W Ocean Boulevard which is the beginning of three alternative pipeline projects (9B, 9C, and 9D); Projects No. 9B, 9C, and 9D are contingent on Project No. 9A. Project No. 9B serves TOPKO and two site of Montenay Pacific Power Corp with a total recycled water demand of 487.7 acre-ft/yr. Project No. 9C serves National Gypsum Division and two sites of BP West Coast Products with a total recycled water demand of 796.9 acre-ft/yr. Project No. 9D serves THUMS Long Beach and TOPKO with a total recycled water demand of 628 acre-ft/yr.

Project No. 10 is an alternative pipeline to serve two Montenay Pacific Power Corporation sites on Henry Ford Avenue with a combined estimated recycled water demand of 424.1 acre-ft/yr. This alternative would take recycled water from the existing Terminal Island recycled water pipeline owned by the City of Los Angeles Department of Water and Power to serve the Montenay Pacific Power Corporation sites. Further investigation would be required to assess the feasibility of this alternative, therefore the alignment, capital costs and prioritization of this pipeline project is not determined.

Project No. 11 begins at Wardlow Road and Walnut Avenue. Project No. 11A extends west to serve the Golf Learning Center, Veterans Park Community Center and Memorial Medical Center with a total recycled water demand of 134.5 acre-ft/yr. Project 11B is extended from Project No. 11A at the intersection of Wardlow Avenue and Pine Avenue. This project serves most customers west of the Los Angeles River Flood Channel such as the Orange County Nursery, Silverado Park, Windward Village, Springdale Preservation Ltd, Long Beach Parks Recreation & Marine, and Cabrillo High School with total recycled water demand of 184.7 acre-ft/yr. Project No. 11B ends at the intersection of Pier B Street and Edison Avenue, which connects with the Project 9C pipeline alignment.

6.5 FUTURE SYSTEM EVALUATION

Under the future system evaluation, low pressures occur due to increase in demands, especially within the northwest area of the LBWD recycled water system. However, these pressures are marginally under the 40 psi criterion and occur only for a few hours over the peak demand week.

It is recommended that the South Lake pump station be operated continuously to maintain system pressures above 40 psi under future conditions. Recommendations to retrofit the pump station have been discussed in **Section 2**. These pressure issues can also be addressed by demand management measures implemented by LBWD which requires customers causing huge peaks in demands to shift their usage to another time period over the course of the day.

6.6 RECYCLED WATER SYSTEM SIZING

6.6.1 Proposed Pipeline Sizing

Once the alternative pipeline alignments are developed to meet future recycled water demands, the pipelines are sized to meet minimum system pressures and velocities using the hydraulic model. The pipeline sizing is based on the criteria listed in **Table 6-3**. A summary of required pipeline diameter and length are presented in **Figure 6-4** for each alternative.

Table 6-3
Proposed Pipeline Sizes

Segment	Length (feet) by Diameter							Total (feet)
	4-inch	6-inch	8-inch	12-inch	16-inch	18-inch	20-inch	
1A	0	550	0	1,370	0	0	0	1,920
1B	0	1,900	2,430	7,920	0	0	0	12,230
1C	0	2,020	3,380	0	0	0	0	5,390
2	4,700	0	0	0	0	0	0	4,700
3	4,300	0	0	0	0	0	0	4,300
4	1,340	0	0	0	0	0	0	1,340
5	2,170	0	0	0	0	0	0	2,170
6	1,020	0	0	0	0	0	0	1,020
7A	0	0	0	0	11,930	0	0	11,930
7B	1,160	1,550	0	0	5,100	6,830	0	14,630
7C	2,060	1,320	0	0	16,170	0	0	19,540
8	0	790	0	0	0	0	0	790
9A	0	2,230	1,260	0	0	0	21,030	24,500
9B	0	0	0	0	5,340	0	0	5,340
9C	0	0	0	0	12,350	0	0	12,350
9D	0	2,160	0	0	8,610	0	0	10,770
11A	0	9,630	3,270	6,290	0	0	0	19,180
11B	0	6,340	0	24,440	0	0	0	30,770
Total	**16,750**	**28,490**	**10,340**	**40,020**	**59,500**	**6,830**	**21,030**	**182,870**

Central Basin MWD Existing RW Pipeline

Hamilton Middle School

Project No. 1C

Ken Kohara

Paradise Gardens, LP
Long Beach Villa Park, LLC

Houghton Park

De Forest Park

Los Coyotes WRP

Lakewood Existing RW Pipeline

Cerritos Existing RW Pipeline

West Basin MWD Existing RW Pipeline

Lakewood Elementary

Parwood Apartments

Project No. 1B

LA County Community Development

Project No. 1A

Bolivar Park

Carson Regional WRP

Virginia Lake PS

Hoover Jr High School

Hubert Howe Bancroft Jr High School

South Lake PS

Project No. 2

Medico Professional Linen

Golf Learning Center

Back-up PS

Orange County Nursery

Project No. 11A

Project No. 3

Silverado Park

John Marshall Middle School

Springdale Preservation Ltd

Windward Village

Cal Trans

Long Beach Airport Marriott

Veterans Park Community Center

US Filter

Project No. 6

Milliken High School

Memorial Medical Center

P.S. Business Park

Project No. 4

Project No. 11B

Costco

BP Oil Refinery

Project No. 5

Stanford Middle School

L B Parks Recreation & Marine

Vander Lans Water Treatment Facility

Long Beach WRP and El Dorado/THUMS PS

Cabrillo High School

Alamitos Tank Nos. 21, 22 & 23

Long Beach Polytechnic High School

American Textile Maint Co

Project No. 8

16-in for Project 7A
18-inch for Project 7B

Project Nos. 7A & 7B

National Gypsum Division

Cal State Long Beach

Walter Hill Middle School

Haynes Generating Station

BP West Coast Products

BP West Coast Products

Project No. 9C

Veterans Affairs Medical Hospital

Terminal Island Existing RW Pipeline

Project No. 7C

16-in for Project 7A
18-in for Project 7B

Harbor Generating Station

Cesar Chavez Elementary

Project No. 9A

Bixby Village Golf Course

AES Southland LLC

Project No. 9B

TOPKO

Hyatt Regency Hotel
Rainbow Harbor Esplanade

Belmont Shore Investors LLC

AES Southland LLC

Montenay Pacific Power Corp

Long Beach Shoreline Marina

Marina Pacifica Housing Association

Haynes Generating Station

Montenay Pacific Power Corp

Project No. 9D

THUMS Long Beach

TOPKO

Terminal Island WRP

Notes:

Project 7A serves Haynes Generating Station on 2nd Street only.
Project 7B serves Haynes Generating (2), AES Southland LLC (2), and Walter Hill Middle School.
Project 7C serves all customers along alignment 7C including Haynes Generating Station and AES Southland LLC on 2nd Street.

Keys to Features

- Facilities
- City Boundary
- Freeway
- Street

Existing Pipeline

- City of Cerritos and Lakewood
- West Basin Municipal Water District
- Central Basin Municipal Water District
- Terminal Island
- Long Beach Water Department

Potential Pipeline

- 4-inch
- 6-inch
- 8-inch
- 12-inch
- 16-inch
- 18-inch
- 20-inch

Likelihood of Recycled Water Customer Conversion

Most Probable	Other	Demand
		< 19.5 AFY
		>= 19.5 - 50 AFY
		> 50 - 150 AFY
		> 150 - 300 AFY
		> 300 AFY

* Customer Name labeled for demands >= 19.5 AFY

N

Feet
0 2,200 4,400

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Date: August 6, 2010

Potential Recycled Water Customers and Pipeline Sizing

Long Beach Water Department

Figure 6-4

MWH

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6.7 CAPITAL COST FOR ALTERNATIVES

The capital costs for the proposed projects are presented in this subsection. A Class 5 opinion of probable construction costs (i.e., a conceptual level estimate) is provided for the recommended projects based on very limited available information. According to Association for the Advancement of Cost Engineering (AACE):

"Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 2% to 10% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances."

A summary of the capital costs for the proposed projects are shown in **Table 6-4**.

6.8 ECONOMICS AND PRIORITIZATION

An economic cost analysis is prepared to determine the prioritization of the proposed projects. The payback period is used to prioritize the projects, which is determined by the total potential demand along the proposed pipeline alignment divided by the potential gains from those customers. The prioritization of the projects are presented in **Table 6-5**. Project No. 8 is most feasible with a total recycled water demand 102 acre-feet/yr, total capital cost of $240,000, and is estimated to take 13 years to pay off the capital costs from the revenue received from the customers. Project No. 9A by itself is the least feasible with a payback period of 386 years. However, if projects 9A, 9B, 9C, and 9D are treated as a single project, then the payback period reduces to 55 years thereby increasing its feasibility.

Table 6-4
Capital Costs for Proposed Projects

Alternative	Total Demand by Alternative (acre-feet)	Total Capital Costs ($)
1A	52	750,000
1A+1B	172	5,010,000
1A+1B+1C	216	7,010,000
2	21	1,140,000
3	32	1,010,000
4	39	320,000
5	24	1,120,000
6	20	250,000
7A	1,000	7,010,000
7B	1,413	7,590,000
7C	1,363	9,570,000
8	102	240,000
9A	128	16,640,000
9A+9B	581	19,800,000
9A+9C	925	23,950,000
9A+9D	756	22,400,000
9A+9B+9C+9D	2,006	32,870,000
11A	134	7,850,000
11B	185	12,390,000

Notes: Alternative 1B can be constructed only after Alternative 1A is constructed.
Alternative 1C can be constructed only after Alternative 1A and 1B is constructed.
Alternative 9B can be constructed only after Alternative 9A is constructed.
Alternative 9C can be constructed only after Alternative 9A is constructed.
Alternative 9D can be constructed only after Alternative 9A is constructed.

Table 6-5
Prioritized Projects

Priority No.	Alternative	Total Demand by Alternative (acre-feet/yr)	Total Capital Costs ($)	Payback Period (years)
1	8	102	240,000	13
2	4	39	320,000	24
3	7B	1,413	7,590,000	29
4	7C	1,363	9,570,000	34
5	7A	1,000	7,010,000	38
6	6	20	250,000	38
7	1A	52	750,000	42
8	9A+9B+9C+9D	2,006	32,870,000	55
9	1A+1B	172	5,010,000	86
10	3	32	1,010,000	93
11	1A+1B+1C	216	7,010,000	96
12	9A+9C	925	23,950,000	125
13	5	24	1,120,000	137
14	9A+9D	756	22,400,000	140
15	9A+9B	581	19,800,000	155
16	2	21	1,140,000	157
17	11A	134	7,850,000	173
18	11B	185	12,390,000	199
19	9A	128	16,640,000	386

6.9 RECOMMENDED PROJECTS

Projects that are more likely to occur in the near-term are presented in **Table 6-6**. These projects are recommended pipeline alternatives that will serve the "most probable" customers or the customers that have the highest potential of converting to recycled water in the near term. These customers have either expressed interest in recycled water conversion or are located near an existing LBWD recycled water pipeline. The customers shown in **Table 6-7** are located along the highest ranked pipeline alternatives shown in **Table 6-5**, except customers from Alternative 9C (not included due to the questionable feasibility of converting a major customer along that pipeline to recycled water) and Medico Linen, which is located along an existing recycled water pipeline. The most probable customers have a total annual recycled water demand of 2,505 acre-ft.

Table 6-6
Most Probable Projects

Segment No.	ID	Owner	Name	Likelihood of Conversion (Yes/No)	Usage Type	Category	Service Address	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)	Peaking Factor (PHD/ADD)	Peak Hour Demand (gpm)	Source
Project No. 1												
1A	11	L A County Community Develop	L A County Community Development	Yes	Residential	Irrigation	801 Via Carmelitos	52.3	32.5	7.4	239.5	Largest 50 Potable Customers
							Project No. 1A Total	52.3	32.5		239.5	
Project No. 4												
4	16	L B Unified School District	Milliken High School	Yes	School	Irrigation	2800 Snow den Ave	39.3	24.4	7.4	180.0	All Potable Irrigation Customers
							Project No. 4 Total	39.3	24.4		180.0	
Project No. 6												
6	49	Long Beach Airport Marriott	Long Beach Airport Marriott	Yes	Hotel	Irrigation	4700 Airport Plaza Dr	19.5	12.1	7.4	89.2	Largest 50 Potable Customers
							Project No. 6 Total	19.5	12.1		89.2	
Project No. 7												
7A[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
							Project 7A Total	1000.0	620.0		2479.8	
7B[1]	4	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	6801 E 2nd St	1000.0	620.0	4.0	2,479.8	Largest 50 Potable Customers
7B	15	L A Department Water & Pow er	Haynes Generating Station	Yes	Pow er	Industrial	1116 Stevely Ave	39.4	24.4	4.0	97.7	Largest 50 Potable Customers
							Project 7B Industrial Subtotal	1039.4	644.4		97.7	
7B	45	L B Unified School District	Walter Hill Middle School	Yes	School	Irrigation	1100 Iroquois Ave	20.2	12.6	7.4	92.6	All Potable Irrigation Customers
							Project 7B Irrigation Subtotal	20.2	12.6		92.6	
							Project 7B Total	1059.6	656.9		190.3	
							Project No. 7 Total	1059.6	656.9		190.3	
Project No. 8												
8	7	American Textile Maint Company	American Textile Maintenance Co.	Yes	Commercial Laundry	Industrial	1340 Orizaba Ave	102.3	63.4	1.3	84.6	Largest 50 Potable Customers
							Project No. 8 Total	102.3	63.4		84.6	
Project No. 9												
9A	46	Hyatt Regency Hotel	Hyatt Regency Hotel	Yes	Hotel	Irrigation	200 S Pine Ave	20.0	12.4	7.4	91.4	Largest 50 Potable Customers
9A	12	Long Beach Parks Rec & Marine	Long Beach Shoreline Marina	Yes	Park	Irrigation	400 Shoreline Village Dr	50.4	31.3	7.4	230.7	All Potable Irrigation Customers
9A	38	L B Marine Bureau	Rainbow Harbor Esplanade	Yes	Park	Irrigation	290 S Pine Ave	22.5	14.0	7.4	103.0	All Potable Irrigation Customers
							Project 9A Total	92.9	57.6		425.1	
9B	24	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1755 Pier D Ave	29.0	18.0	2.0	36.0	Port of Long Beach Customer
9B	3	Montenay Pacific Pow er Corp	Montenay Pacific Pow er Corp	Yes	Pow er	Industrial	100 Henry Ford Ave	394.9	244.8	4.0	979.3	Largest 50 Potable Customers
9B	23	Montenay Pacific Pow er Corp	Montenay Pacific Pow er Corp	Yes	Pow er	Industrial	100 Henry Ford Ave	29.2	18.1	4.0	72.3	Largest 50 Potable Customers
							Project 9B Industrial Subtotal	453.1	280.9		1087.6	
9B	20	City of Long Beach	Cesar Chavez Elementary	Yes	School	Irrigation	910 W Broadw ay	34.7	21.5	7.4	158.6	All Potable Irrigation Customers
							Project 9B Irrigation Subtotal	34.7	21.5		158.6	
							Project 9B Total	487.7	302.4		1246.2	
9D	2	THUMS Long Beach	THUMS Long Beach	Yes	Oil	Industrial	1035 S Harbor Scenic Dr	592.0	367.0	2.0	734.0	Port of Long Beach Customer
9D	19	TOPKO	Tidelands Oil Production Company	Yes	Oil	Industrial	1277 S Harbor Scenic Dr	36.0	22.3	2.0	44.6	Port of Long Beach Customer
							Project 9D Total	628.0	389.3		778.7	
							Project No. 9 Total	1208.6	749.3		2449.9	

1 Customers on multiple proposed pipeline alignment options.

Note: Most Probable customers for Project No. 7B does not include AES Southland, LCC

Table 6-7
Most Probable Customers

No.	ID	Name	Usage Type	Estimated RW Demand (acre-ft/yr)	Estimated RW Demand (gpm)
1	2	THUMS Long Beach	Oil	592.0	367.0
2	3	Montenay Pacific Power Corp	Power	394.9	244.8
3	4	Haynes Generating Station	Power	1000.0	620.0
4	7	American Textile Maintenance Co.	Commercial Laundry	102.3	63.4
5	11	L A County Community Development	Residential	52.3	32.5
6	12	Long Beach Shoreline Marina	Park	50.4	31.3
7	15	Haynes Generating Station	Power	39.4	24.4
8	16	Milliken High School	School	39.3	24.4
9	19	Tidelands Oil Production Company	Oil	36.0	22.3
10	20	Cesar Chavez Elementary	School	34.7	21.5
11	23	Montenay Pacific Power Corp	Power	29.2	18.1
12	24	Tidelands Oil Production Company	Oil	29.0	18.0
13	36	Medico Professional Linen	Commercial Laundry	23.2	14.4
14	38	Rainbow Harbor Esplanade	Park	22.5	14.0
15	45	Walter Hill Middle School	School	20.2	12.6
16	46	Hyatt Regency Hotel	Hotel	20.0	12.4
17	49	Long Beach Airport Marriott	Hotel	19.5	12.1
			TOTAL	**2,505**	**1,553**

Section 7
Storage Evaluation and Comparison of Supplies and Demand

7.1 INTRODUCTION

This section compares Long Beach Water Department's (LBWD) recycled water supplies and demands under existing and future demand conditions. The amount of storage required to meet peak demands under future conditions is also presented. This section also presents a detailed analysis on the amount of recycled water available for the Water Replenishment District of Southern California's (WRD) Leo VanderLans (LVL) treatment facility under future demand conditions.

As discussed in **Section 3**, LBWD has the rights to all flow produced at Sanitation Districts of Los Angeles County's (LACSD) Long Beach Water Reclamation Plant (LBWRP). On a summer day, the minimum supply available from the LBWRP is 14.9 million gallons per day (mgd). As discussed in **Section 4 – Summary of Existing Customers**, recycled water is served to a number of irrigation customers and two industrial users: Water Replenishment District's (WRD) Leo VanderLans Water Treatment Facility (LVL) and THUMS. There is an existing maximum day recycled water demand of 11.4 mgd. It should be noted that conservation practices implemented by LBWD may affect both recycled water supplies and demands in the future.

7.2 COMPARISON OF AVAILABLE SUPPLES AND EXISTING DEMANDS

Existing demands disaggregated by the three main user categories (irrigation, LVL, and THUMS) are shown on **Figure 4-4** in **Section 4** of this report. The varying peaks in the irrigation demands are clearly seen while the other large users, THUMS and LVL show fairly steady demands over the year. **Figure 7-1** shows a comparison of the existing demands and the available supplies. The available supply is assumed to be 14.9 mgd. A review of **Figure 7-1** indicates if all of the excess recycled water could be captured in storage reservoirs, then additional supplies ranging from 3 mgd to 14 mgd are available to meet additional future demands.

On a maximum demand day (MDD) basis, there is an existing demand of 11.4 mgd compared to an existing available supply of 14.9 mgd. Thus, under existing MDD conditions, there is an additional 3.5 mgd available to be served to future customers as shown in **Table 7-1** and **Figure 7-2**. On an hourly basis, there are some hours with demands greater than available supplies, however, existing demands above the hourly supply can be met from storage at the Alamitos Tank Farm which currently has a total recycled water storage of 10 million gallons (MG).

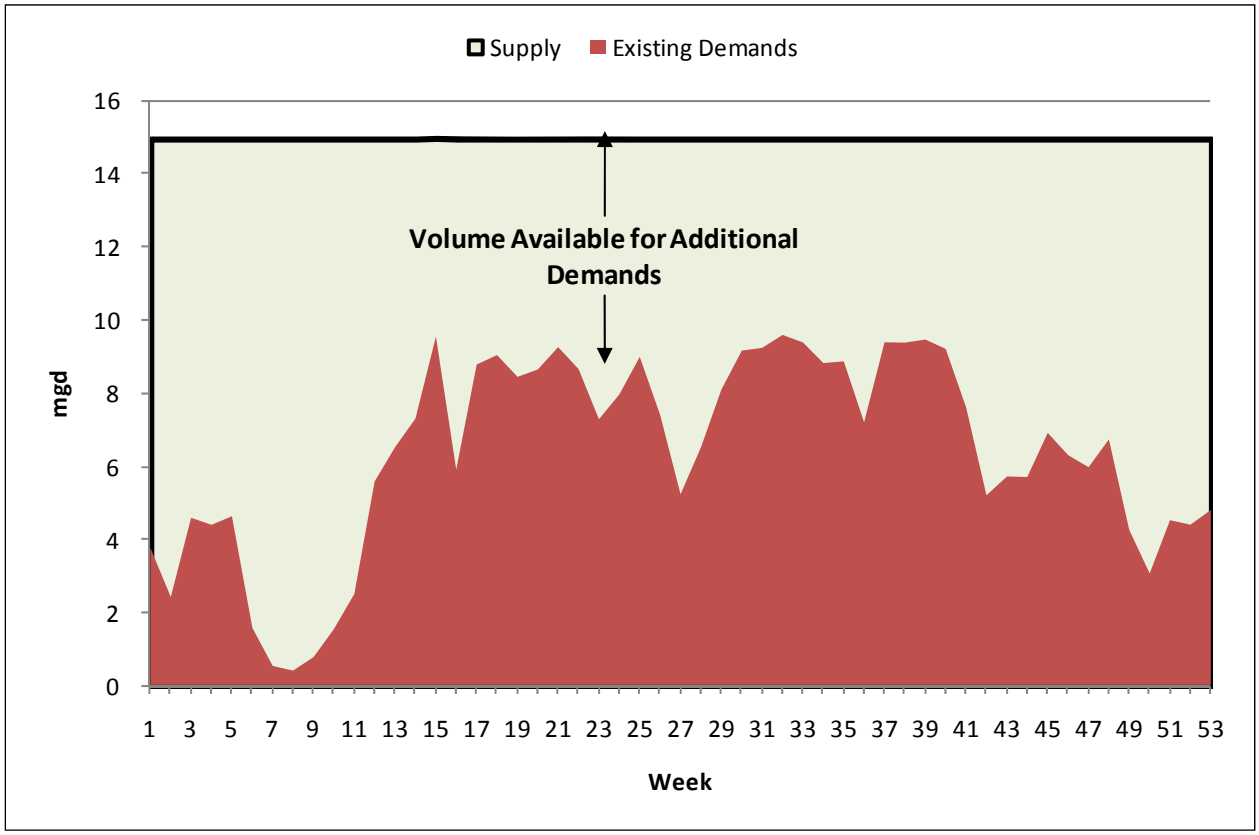


Figure 7-1
Comparison of Existing Demands and Supplies by Week

7.3 COMPARISON OF AVAILABLE SUPPLIES AND FUTURE DEMANDS

A comparison of future demands and supplies is presented in this sub-section. Future demands include the potential customers identified in **Section 5 – Summary of Potential Customers**. Future demands also include the proposed expansion of WRD's LVL facility whose demands for the sea-water barrier injection will increase from 3.9 mgd to approximately 7.8 mgd. For this comparison, recycled water is assumed to be available to WRD's LVL facility after LBWD's potential customer needs are met. Therefore, the total future demands are equal to the available supplies. **Figure 7-3** presents LBWD's recycled water demands under future conditions on a weekly basis where total demands are equal to the available supplies (14.9 mgd) and unlimited storage is available to capture all available supplies.

Table 7-1
Existing Maximum Day Demand and Supply Comparison

Hour	WRD Demands (gpm)	THUMS Demands (gpm)	Irrigation Demands (gpm)	Total Hourly Demand (gpm)	Total Hourly Supply (gpm)
0:00	2,985	645	10,833	14,463	10,915
1:00	2,990	814	9,122	12,926	10,105
2:00	2,956	830	8,067	11,853	8,342
3:00	2,972	486	10,960	14,417	6,607
4:00	3,023	523	4,653	8,199	5,283
5:00	2,995	688	4,141	7,823	3,754
6:00	3,010	495	1,562	5,068	3,240
7:00	2,987	454	2,218	5,659	3,486
8:00	3,014	768	1,645	5,427	4,122
9:00	3,023	738	271	4,031	7,820
10:00	3,019	708	1,009	4,735	11,626
11:00	3,031	621	2,252	5,903	14,497
12:00	3,054	649	2,050	5,754	15,061
13:00	3,027	724	3,127	6,878	15,173
14:00	3,087	593	2,223	5,902	14,512
15:00	3,108	489	2,177	5,774	14,074
16:00	2,981	559	2,550	6,090	14,034
17:00	2,949	644	1,930	5,523	13,228
18:00	2,969	871	888	4,728	12,558
19:00	2,963	473	1,338	4,774	12,578
20:00	3,013	605	1,307	4,925	12,065
21:00	2,990	552	7,599	11,142	12,031
22:00	2,919	549	8,538	12,006	12,065
23:00	2,930	487	10,874	14,290	11,725
Average (gpm)	**3,000**	**623**	**4,222**	**7,845**	**10,371**
Average (mgd)	**4.3**	**0.9**	**6.1**	**11.3**	**14.9**

7.4 AVAILABLE FLOWS TO WRD'S LVL FACILITY

The amount of future demand at WRD's LVL may be dependent on the amount of flow available to LVL. The amount of flow available to LVL is presented under three LBWD demand conditions:

- **Figure 7-4** shows the amount of flow available to LVL on a weekly basis based on no additional LBWD demands. This is indicative of available flows in the immediate short-term.
- **Figure 7-5** shows the amount of flow available to LVL on a weekly basis including the "most probable" LBWD potential customers as presented in **Section 6** of this report.
- **Figure 7-6** shows the amount of flow available to LVL on a weekly basis including all of the LBWD potential customers as presented in **Section 6** of the report.

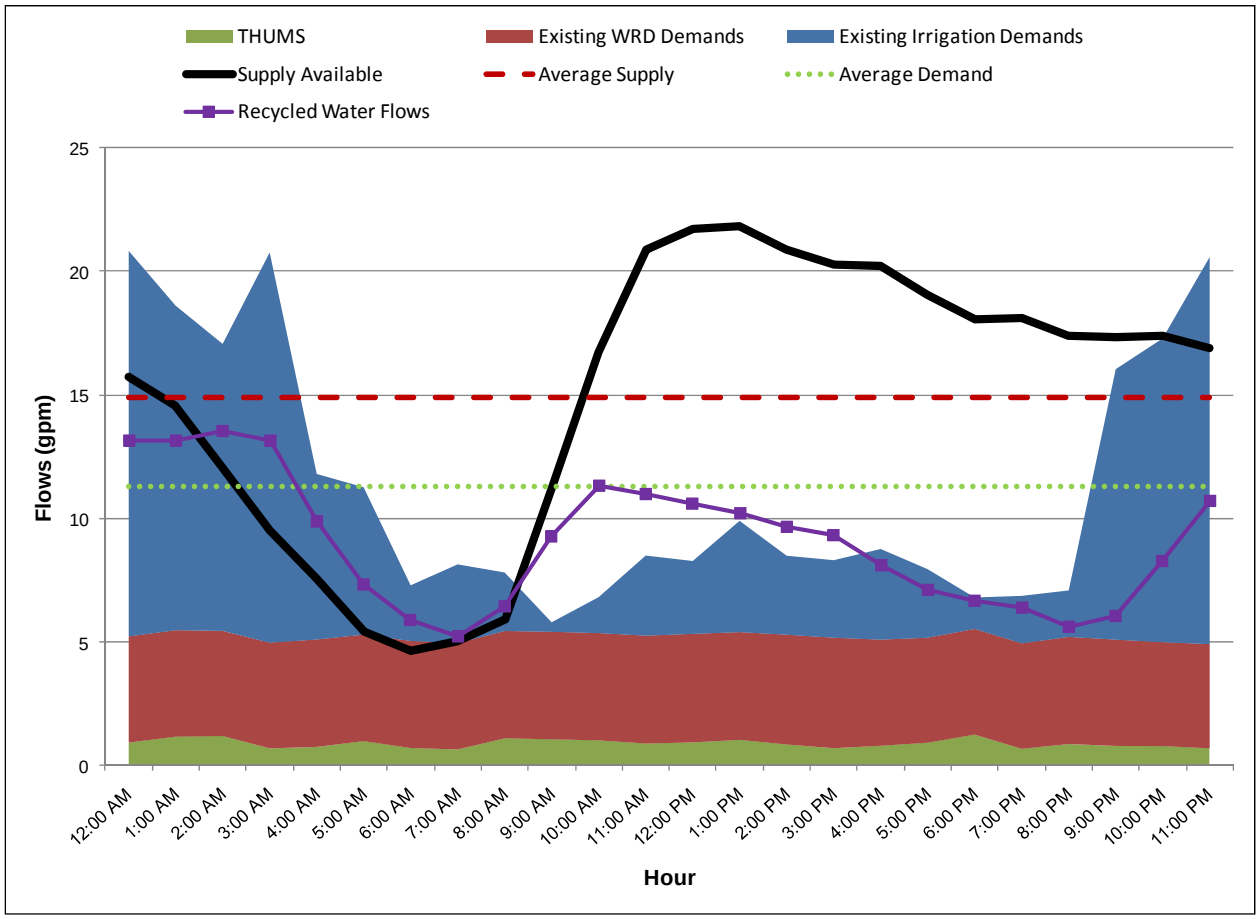


Figure 7-2
Existing Maximum Day Demand and Supply Comparison

The figures also show the amount of available flow to LVL assuming no additional storage, one additional recycled water storage reservoir at Alamitos Hill, and two additional recycled water storage reservoirs at Alamitos Hill. It is seen that adding additional storage does not increase the amount of flow available to LVL significantly. The benefits of added storage are only realized during low demand periods. It is expected that the LVL facility would be operated at a capacity lower than the design capacity during periods of high demand.

Appendix F provides a summary of flows available to WRD's LVL facility on a weekly basis for different conditions.

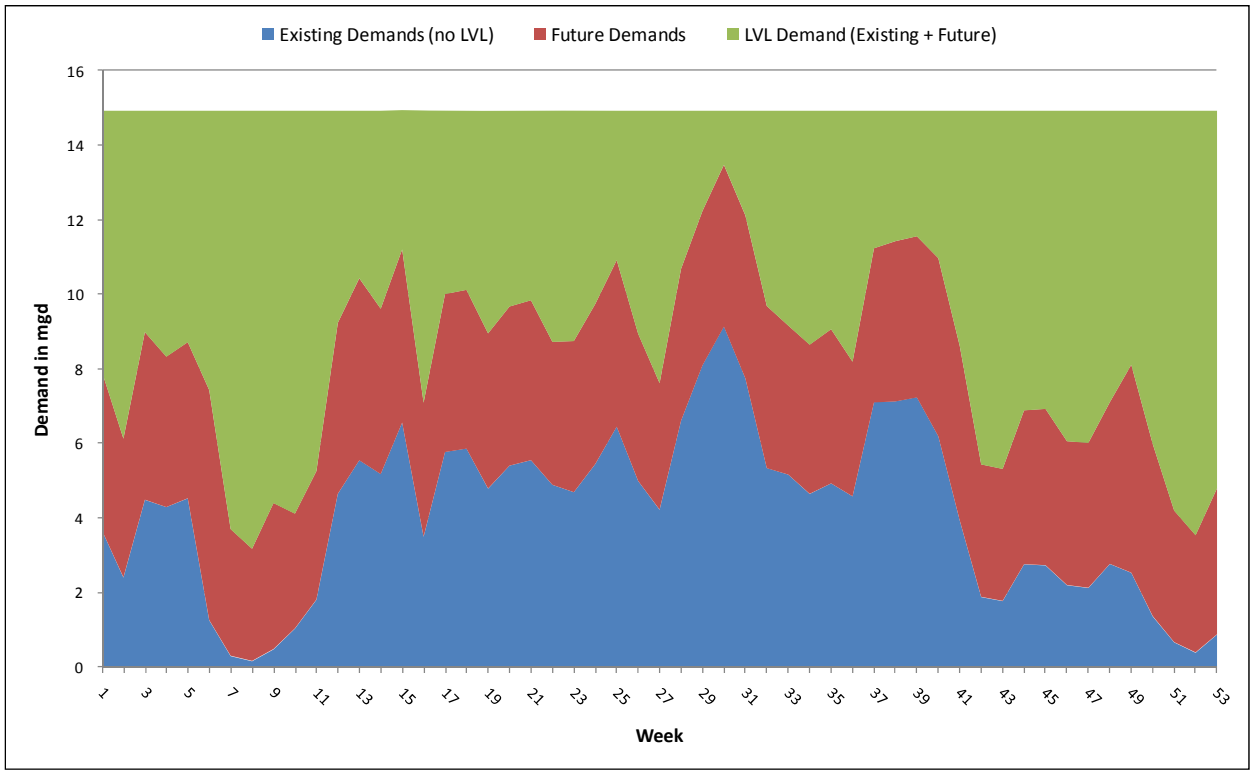


Figure 7-3
LBWD Recycled Water Demands by Week – Future Conditions

7.5 STORAGE REQUIREMENTS

An analysis is performed to determine the storage requirements for LBWD's recycled water system under future demand conditions. The adequacy of the existing storage reservoirs is evaluated under two scenarios:

- Only the "most probable customers" will be converted to recycled water
- All potential customers will be converted to recycled water.

This analysis is conducted for August 2009 conditions; conditions that represent maximum demands and minimum supplies. As discussed in **Section 6**, for future conditions, total storage capacity is assumed to be two times the operational storage requirements.

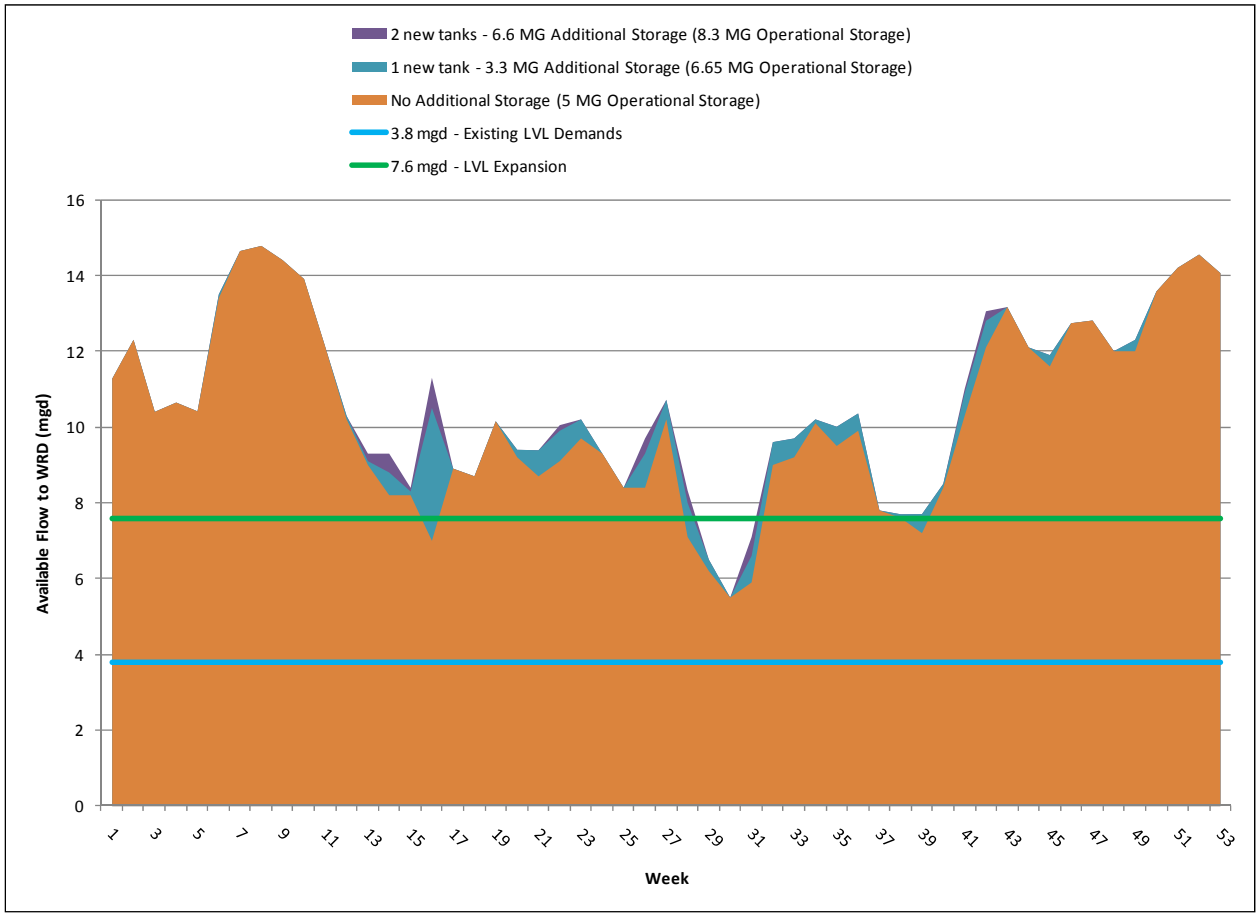


Figure 7-4
Additional Flow Available to WRD's LVL Facility

(No LBWD Future Recycled Water Demands)

If only LBWD's future customers categorized as "most probable" are served (excluding WRD's LVL facility), then the existing storage capacity is sufficient to meet the storage needs. Approximately 4 million gallons of operational storage is required in for this scenario. This equates to a total storage requirement of 8 MG. Currently, LBWD has a total storage capacity of 10 MG at the Alamitos reservoir site.

It is observed that the storage requirements increase significantly if the planned expansion at LVL is accounted as a future demand. The calculations reveal that as the difference between the total demands and the available supplies narrows, the amount of storage required to capture all available recycled water increases significantly. In order to meet the demands of the "most probable customers" and to accommodate the proposed expansion at LVL at a continuous rate of 7.8 mgd, approximately 10.4 MG of operational storage is required. This equates to approximately 20.7 MG of total storage. Storage requirements for WRD's LVL facility would depend on the design flows for the proposed LVL plant expansion. Available flows to WRD's LVL facility have been discussed under **Section 7.4**.

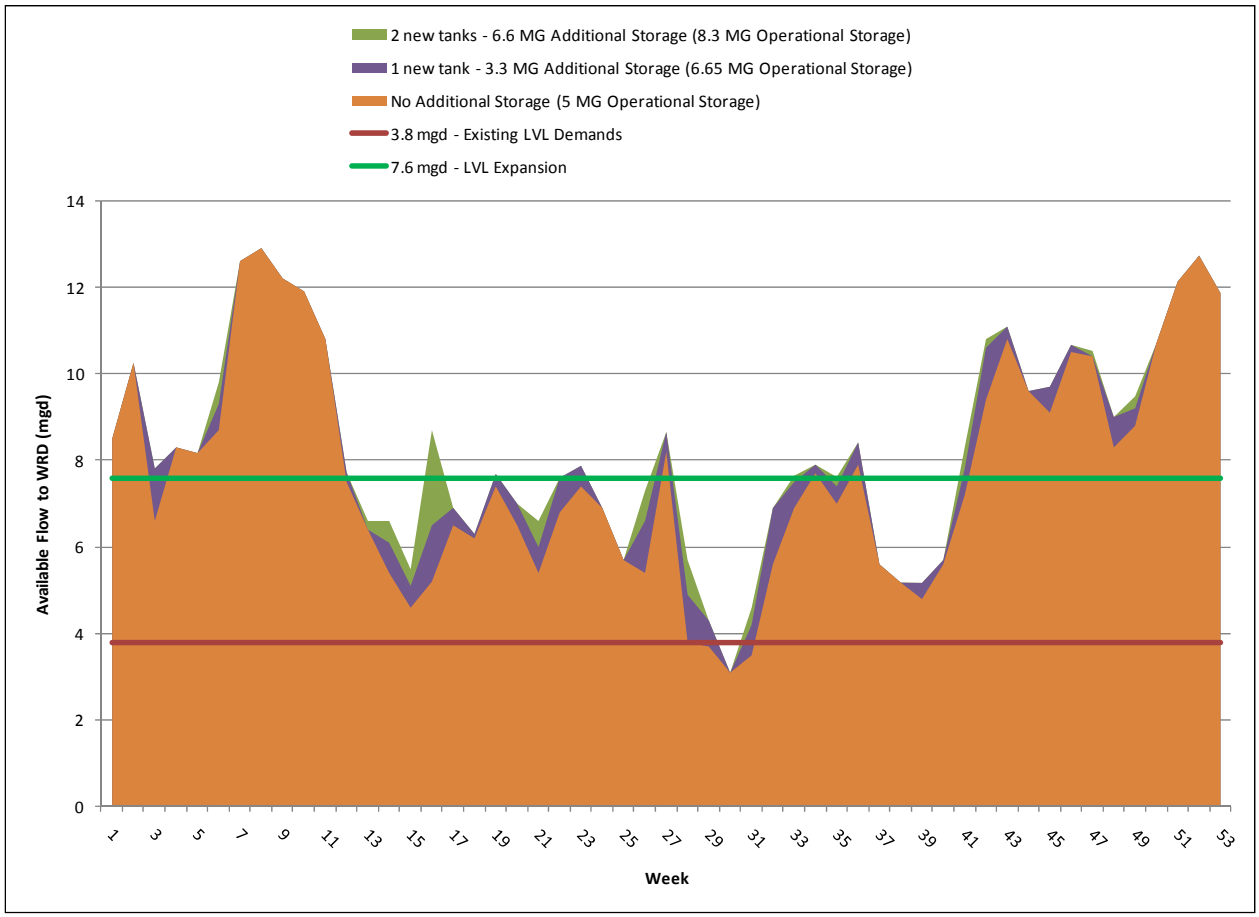


Figure 7-5
Additional Flow Available to WRD's LVL Facility
(Most Probable LBWD Future Recycled Water Demands)

If all future LBWD customers are to be served (without LVL expansion), the operational storage required is approximately 7.2 MG. This equates to a total storage of 14.4 MG.

It should be noted that the amount of recycled water supply available to LBWD is limited by the pumping capacity at LBWD's El Dorado pump station. Currently, there are seven pumps in the pump station with each pump having a nominal pumping capacity of 2,500 gallons per minute (gpm). **Table 7-2** presents results from the hydraulic model and summarizes the flow rates that can be pumped from the El Dorado Pump Station with various numbers of pumps running. It is observed that the flow rate obtained is lower than the actual pumping capacity added at the pump station.

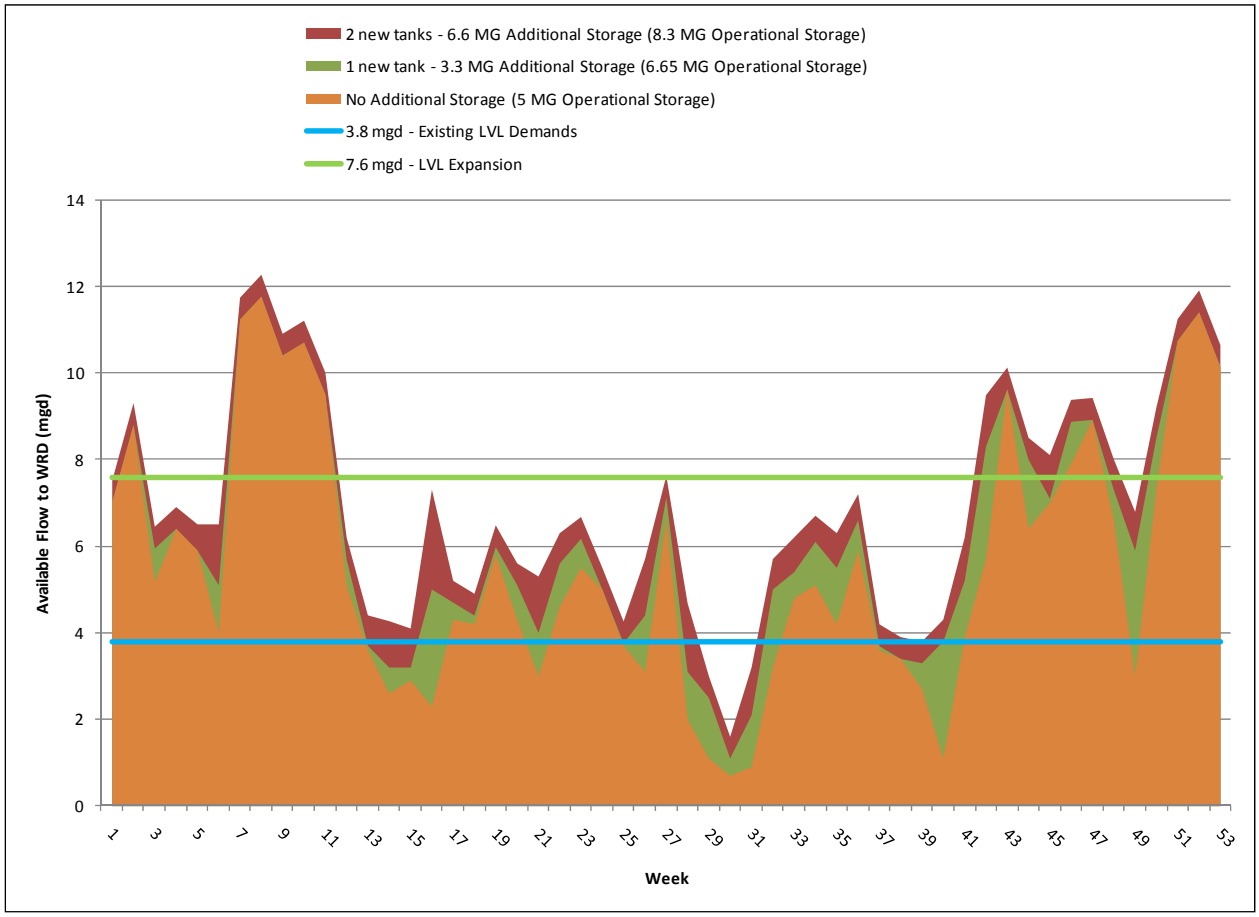


Figure 7-6
Additional Flow Available to WRD's LVL Facility
(All Potential LBWD Future Recycled Water Demands)

Table 7-2
Flow Rates through the El Dorado Pump Station

No of operating pumps	Flow rate (gpm)
5	12,694
6 (One pump on standby)	14,790
7 (All existing pumps running)	16,619
8 (One new pump, all pumps running)	18,192
9 (Two new pump, all pumps running)	19,548

Source: WaterGEMS Hydraulic Model Runs, MWH, 2010.

Table 7-3 summarizes the storage required for different demand scenarios and pumping scenarios. The results summarized in **Table 7-3** do not consider the future recycled water demands from the proposed expansion at WRD's LVL facility. Available flows to WRD's LVL facility under different storage conditions have been discussed under **Section 7.4** and are also presented in **Appendix F**. As shown on **Table 7-3**, the amount of operational storage does not increase substantially even with added pumping capacity at the El Dorado Pump Station. Therefore, it is not recommended that additional pumping capacity be added at the pump station.

Appendix F provides additional details on the storage calculations presented in **Table 7-3.**

Table 7-3
Operational Storage Requirements[(1)]

Scenario	El Dorado PS (15,000 gpm) Operational Storage Required (MG)	El Dorado PS (18,200 gpm) Operational Storage Required (MG)
Existing Demands	2.71	2.71
Existing Demands + Most Probable Customers	3.97	3.97
Existing Demands + All Future Customers	7.16	7.02

[1] This analysis does not consider the proposed expansion at WRD's LVL facility.

7.6 RECOMMENDATIONS

In the near-term, it is expected that the "Most Probable" customers and WRD's proposed LVL expansion would account as potential demands for LBWD's recycled water system. An analysis on the available flows to WRD's LVL facility under different storage conditions has already been presented under **Section 7.4**. However, in order to account for future growth within LBWD's service area, it is recommended to plan for storage assuming that all potential customers will get converted to recycled water. Planning for two new recycled water reservoirs (3.3 MG each) is recommended at the Alamitos reservoir site to provide adequate storage under future demand conditions, with implementation of the reservoirs when the additional storage is required. The storage analysis reveals that the first additional 3.3 MG reservoir will be required when 4.4 mgd of future demand (in addition to the existing recycled water demand) is added to the recycled water system. The second additional 3.3 MG reservoir will be required when 5.8 mgd of future demand (in addition to the existing recycled water demand) is added to the recycled water system.

A portion of this available storage can be provided at the suction side of the El Dorado Pump Station. This would ease system operations because it would allow more constant flows through the El Dorado PS. Based on the land availability at the El Dorado PS (south of the existing pump station), the maximum storage volume is limited to approximately 0.48 MG at the existing site. There may be space elsewhere for such storage.

Due to the uncertainty associated with the conversion of potable water customers to recycled water, a time-frame for the construction of these new reservoirs is not presented. It should be noted that the amount of storage required is sensitive to the assumed peaking factors for future customers. Minor changes to assumed peaking factors for potential industrial customers can have a significant impact on the amount of storage required. Analysis presented under **Section 7.5** assumes a flat-pattern for potential industrial customers.

Section 8
Operational and Infrastructure and Recommendations

This section summarizes the infrastructure and operational recommendations proposed in **Section 2**, **Section 6**, and **Section 7** of this report.

8.1 SOUTH LAKE PUMP STATION

Based on the results of hydraulic modeling for future demand conditions, it is observed that there are certain areas with low pressures (< 40 psi) in the western reaches of LBWD's recycled water system. It is recommended that the South Lake Pump Station be operated continuously to maintain system pressures in the western reaches of the system under future demand conditions. Due to the age of the station, in order to use it on a regular basis, it is recommended that the pump station be rehabilitated, including pump replacement, addition of variable frequency drives (VFD), and upgrades to the electrical equipment. It is recommended that the South Lake pump station be operated such that system pressures at the Longfellow Elementary school are maintained at 40 psi. If this is not feasible operationally, then it is recommended that a discharge pressure of 80 psi be maintained at the pump station.

8.2 EL DORADO PUMP STATION

Due to the significant variation in recycled water supplies over the course of the day, it is recommended that VFDs be installed at the El Dorado Pump Station to pace the flow out of the pump station to the flows available from LACSD. This would assist the operators in obtaining better control over the operation of the pumps, use as much flow as possible, and limit fluctuations in system pressures. It is estimated that adding VFDs at the existing pumps would cost approximately $225,000. No capacity recommendations are included for El Dorado Pump Station.

8.3 RECYCLED WATER CUSTOMERS AND PIPELINES

Potential recycled water customers for LBWD's system have been identified in **Section 5** and are listed in **Table 5-2**. In addition to Water Replenishment District's (WRD) LeoVanderLans Water Treatment Facility (LVL), 17 out of the 49 potential customers are identified as the "most probable customers" to be converted to recycled water in the near-term. These customers have either expressed interest in recycled water conversion or are located near an existing LBWD recycled water pipeline. The pipeline alternatives developed to serve these customers are discussed in **Section 6** and are presented in **Table 6-2**.

The following future recycled water projects are recommended for implementation, in order from highest to lowest priorities. Other alternatives may also be implemented after these highest priority projects are completed:

1. Alternative 8 – Pipeline to American Textile Maintenance Company (Commercial Laundry)
2. Alternative 4 – Pipeline to Millikan High School
3. Alternative 7 – Pipeline to LADWP's Haynes Generating Station
4. Alternative 6 – Pipeline to Long Beach Marriott Hotel
5. Alternative 1A – Pipeline to Los Angeles County Community Development
6. Alternative 9 – Pipeline to Downtown Long Beach and Port of Long Beach (THUMS, Montenay Pacific Power Corporation, and possibly BP West Coast Products as the anchor customers)

The capital costs for the pipeline alternatives that serve the "most probable customers" in the near term are presented in **Table 8-1**.

Table 8-1
Capital Costs for Near-Term Pipeline Projects

Alternative	Total Demand by Alternative (acre-feet/year)	Total Capital Costs ($)
1A	52	750,000
4	39	320,000
6	20	250,000
7A	1,000	7,010,000
7B	1,413	7,590,000
8	102	240,000
9A	128	16,640,000
9A+9B	581	19,800,000
9A+9D	756	22,400,000

Notes: Total construction costs represent year 2010 costs.
Alternative 9B can be constructed only after Alternative 9A is constructed.
Alternative 9D can be constructed only after Alternative 9A is constructed.

Additionally, the following customers located along existing recycled water pipelines should be connected:

- Medico Professional Linen is a potential customer with an estimated recycled water demand of 1.3 gallons per minute (gpm)

8.4 RECYCLED WATER STORAGE

It is recommended that LBWD plan for two recycled water storage reservoirs (3.3 MG each) at the Alamitos reservoir site to meet the storage needs of all potential recycled water customers (excluding the proposed expansion at WRD's LVL facility). The storage analysis reveals that the first additional 3.3 MG reservoir will be required when 4.4 mgd of future demand (in addition to the existing recycled water demand) is added to the recycled water system. The second additional 3.3 MG reservoir will be required when 5.8 mgd of future demand (in addition to the existing recycled water demand) is added to the recycled water system. **Table 8-2** presents the estimated costs for the recommended reservoirs.

Table 8-2
Capital Costs for Near-Term Pipeline Projects

Description	Total Capital Costs ($)
Two 3.3 MG Steel Reservoirs at the Alamitos Reservoir site	2,500,000 (per reservoir)

Notes: Total construction costs represent year 2010 costs.

In the near-term, it is expected that the "most probable" customers and WRD's proposed expansion at the Leo VanderLans (LVL) treatment facility would account as potential demands for LBWD's recycled water system. An analysis on the available flows to WRD's LVL facility under different storage conditions is presented in **Section 7.4**. Storage analysis for LBWD's "most probable" customers indicates that the existing storage at the Alamitos reservoir site is sufficient to meet near-term storage requirements of LBWD's potential customers.

8.5 DEMAND MANAGEMENT

It is recommended that LBWD implement demand management measures under future demand conditions which requires customers causing huge peaks in demands to shift their usage to another time period over the course of the day. Implementing such measures will help reduce pressure fluctuations in the system and will address the low pressure issues (< 40 psi) under future demand conditions in the northwestern area of the system.

8.6 PRESSURE MONITORING

In order to monitor system pressures for the recycled water system, it is recommended that LBWD install pressure monitors at Longfellow Elementary School and Heartwell Park.

Appendix A
Site Visit Photographs

Long Beach Water District – Site Visit

THUMS Pump Station

THUMS Pump Station

Control Panel El Dorado/THUMS

Control Panel El Dorado/THUMS

Hydropneumatic Tank

El Dorado Pump Station

MWH

BUILDING A BETTER WORLD

Long Beach Water District – Site Visit

El Dorado North Flow Meter

El Dorado Pump Station

LACSD's Long Beach WRP

LACSD's Long Beach WRP

LACSD's Long Beach WRP

Leo VanderLans Treatment Plant

MWH

BUILDING A BETTER WORLD

Long Beach Water District – Site Visit

Leo VanderLans Treatment Plant

Leo VanderLans Treatment Plant

Backup Pump Station

Backup Pump Station

Well Pump – Lake El Dorado

Well Pump – Lake El Dorado

MWH

BUILDING A BETTER WORLD

Long Beach Water District – Site Visit

Well Pump – Lake El Dorado

South Lake Pump Station Controls

South Lake Pump Station

South Lake Pump Station

South Lake Pump Station

South Lake Pump Station Flow Meter

MWH

BUILDING A BETTER WORLD

Long Beach Water District – Site Visit

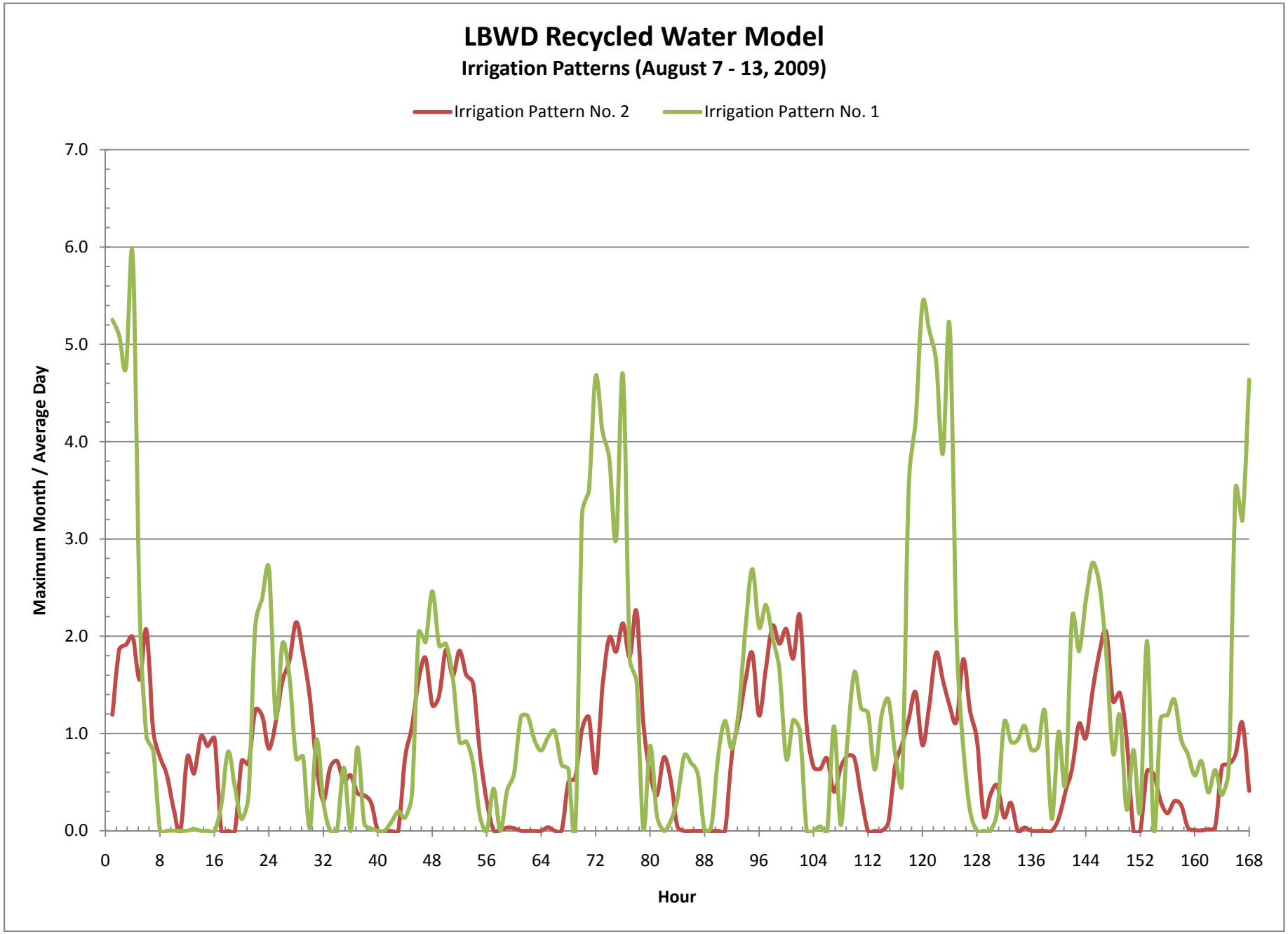
South Lake Flow Meter to Lake

Alamitos Reservoir

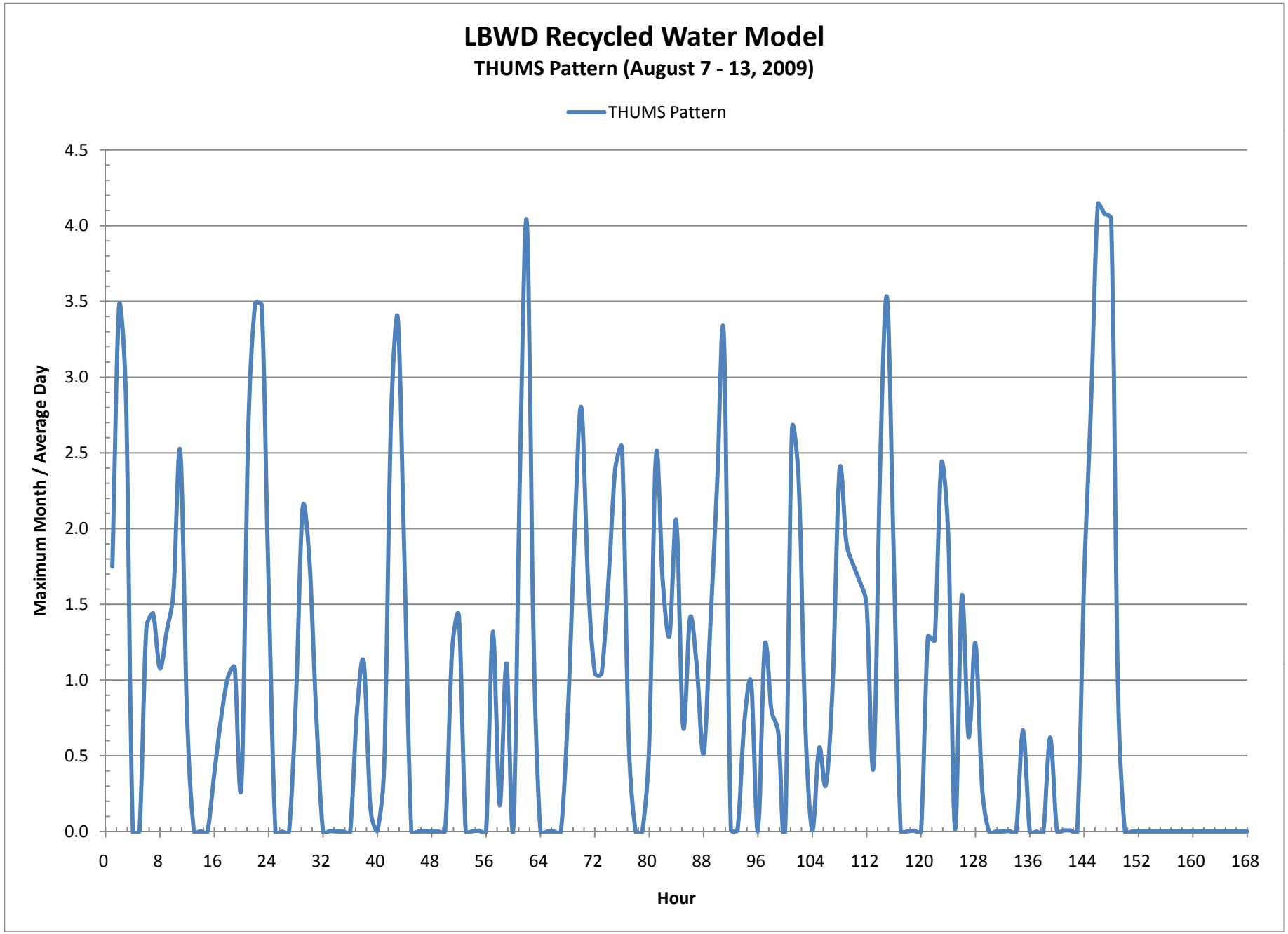
Alamitos Reservoir – RW Storage Tanks

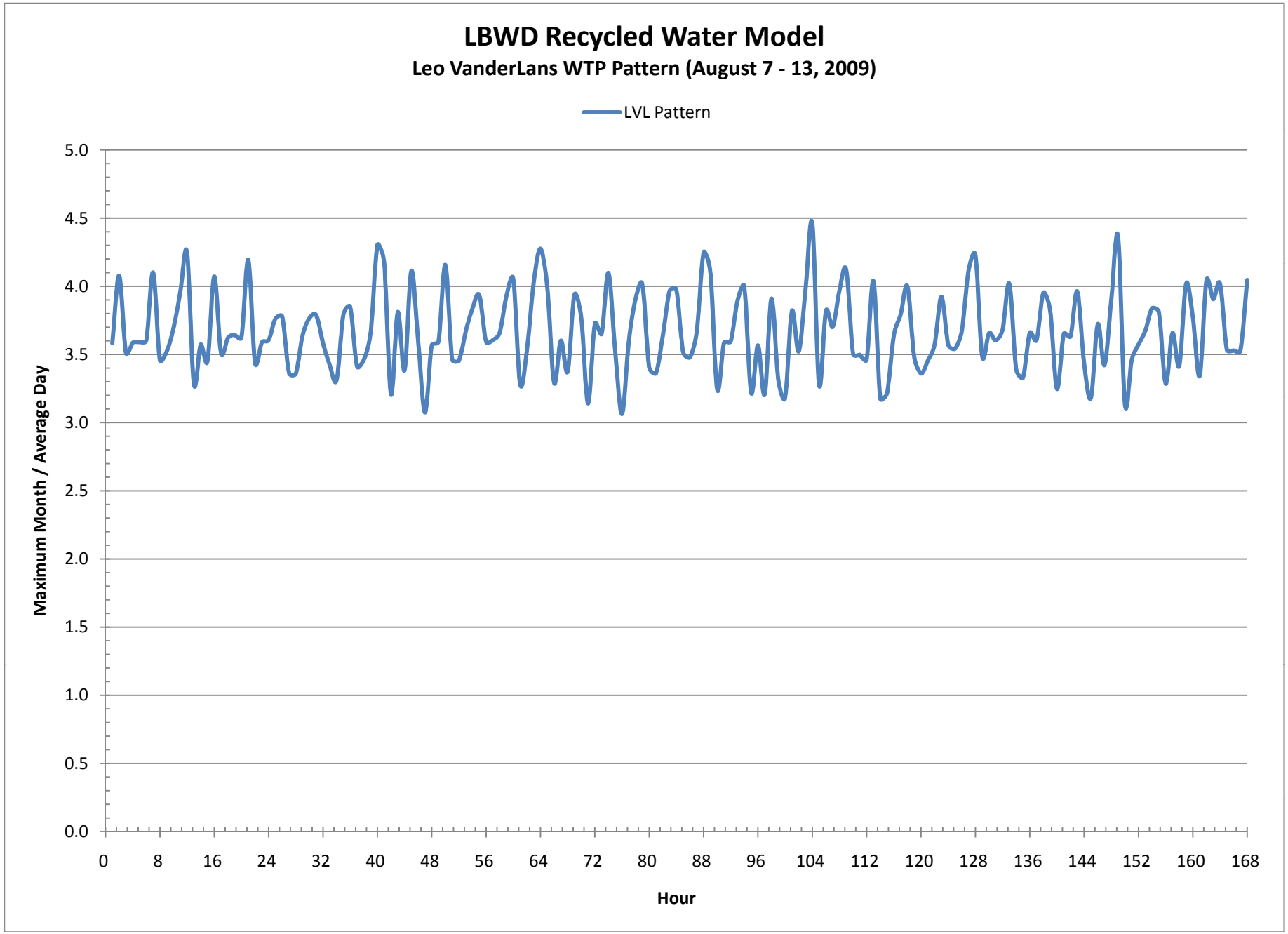
Alamitos Reservoir – RW Storage Tanks

Appendix B
Model Diurnal Patterns

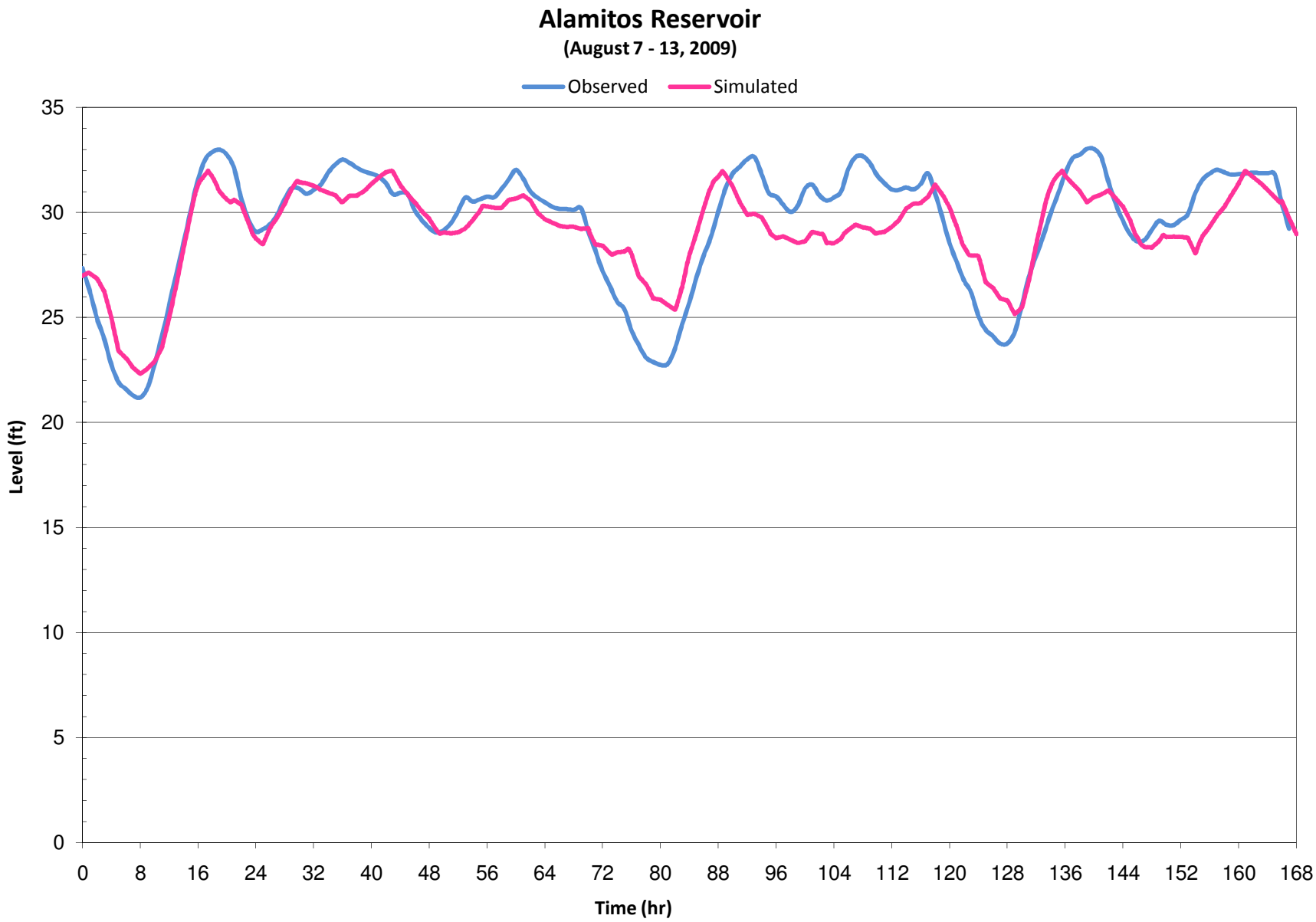


Pattern No. 1 = Area east of South Lake
Pattern No. 2 = Area west of South Lake

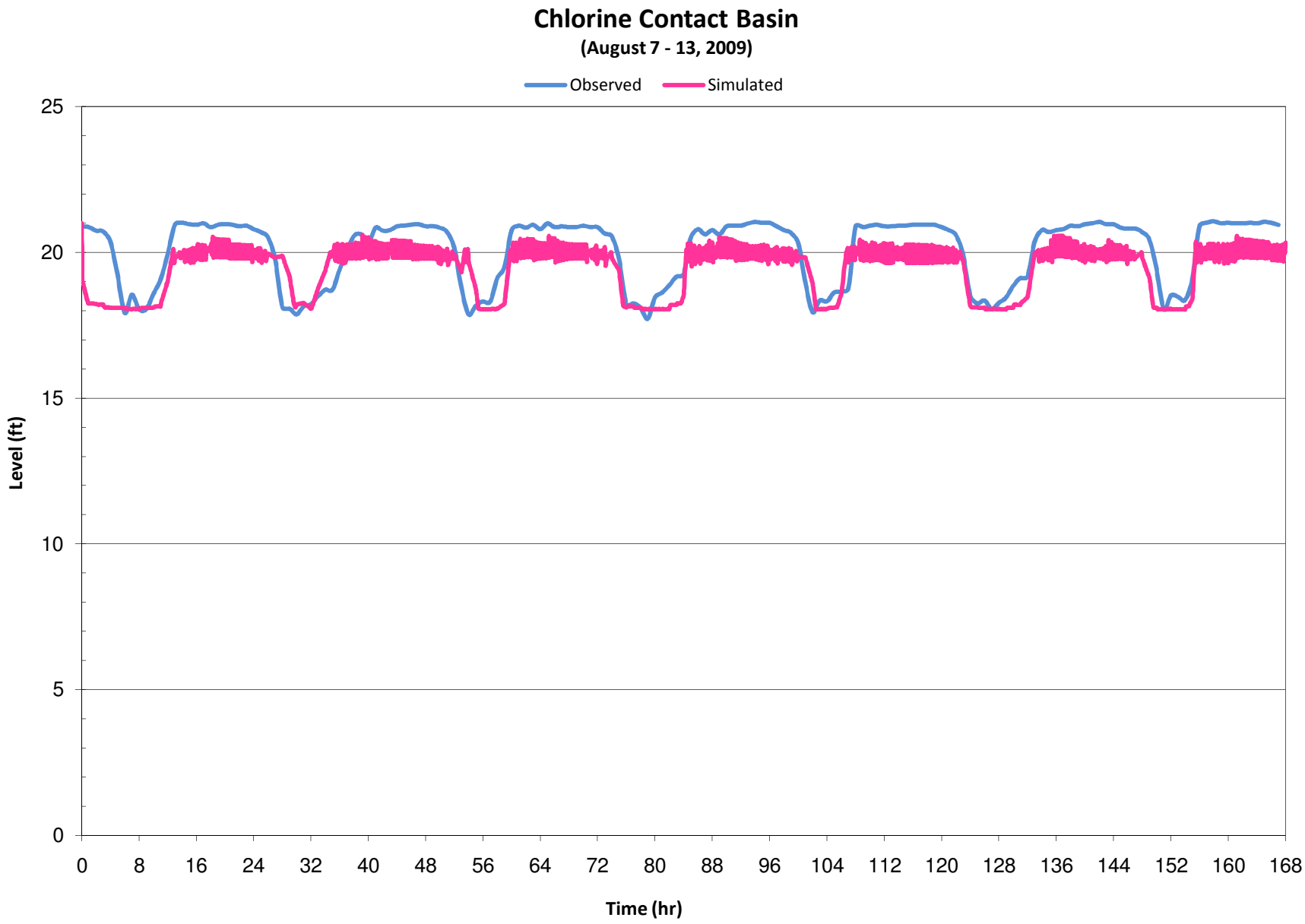

LBWD Recycled Water Model
THUMS Pattern (August 7 - 13, 2009)
THUMS Pattern
Maximum Month / Average Day
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
8
16
24
32
40
48
56
64
72
80
88
96
104
112
120
128
136
144
152
160
168
Hour


LBWD Recycled Water Model
Leo VanderLans WTP Pattern (August 7 - 13, 2009)
LVL Pattern
Maximum Month / Average Day
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
8
16
24
32
40
48
56
64
72
80
88
96
104
112
120
128
136
144
152
160
168
Hour

Appendix C
Model Calibration Graphs



Model Comparisons_20100703.xlsx



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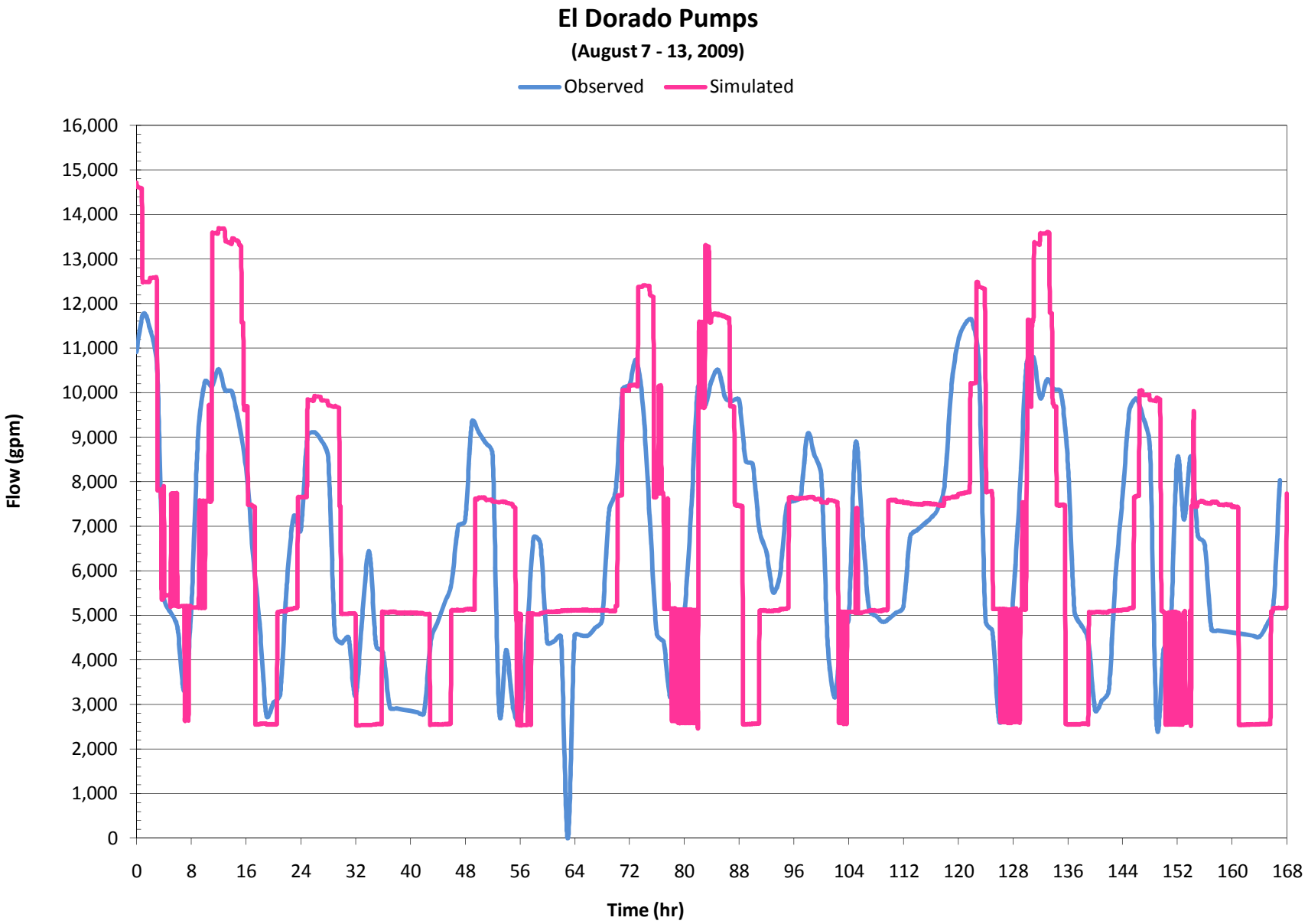
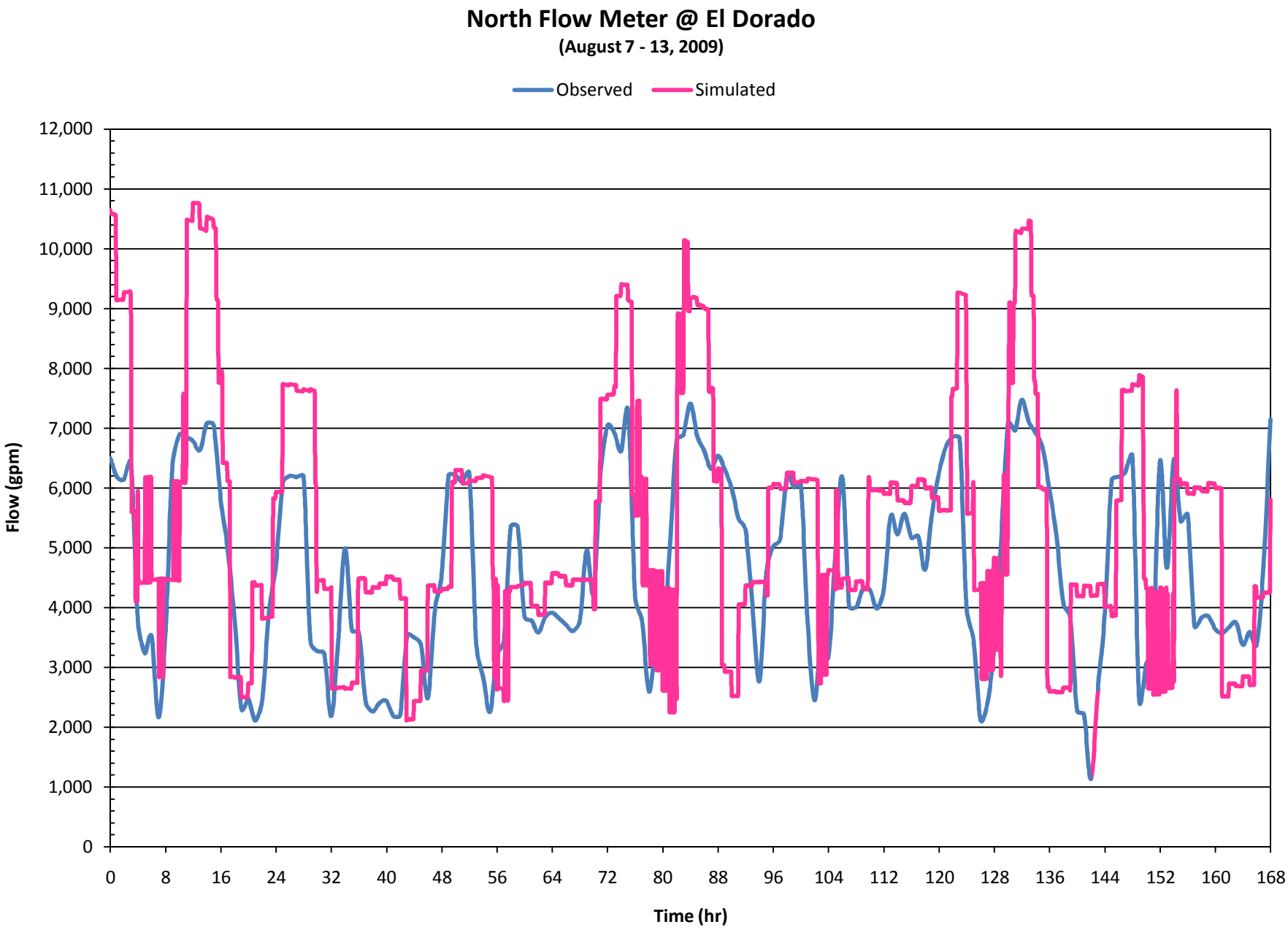
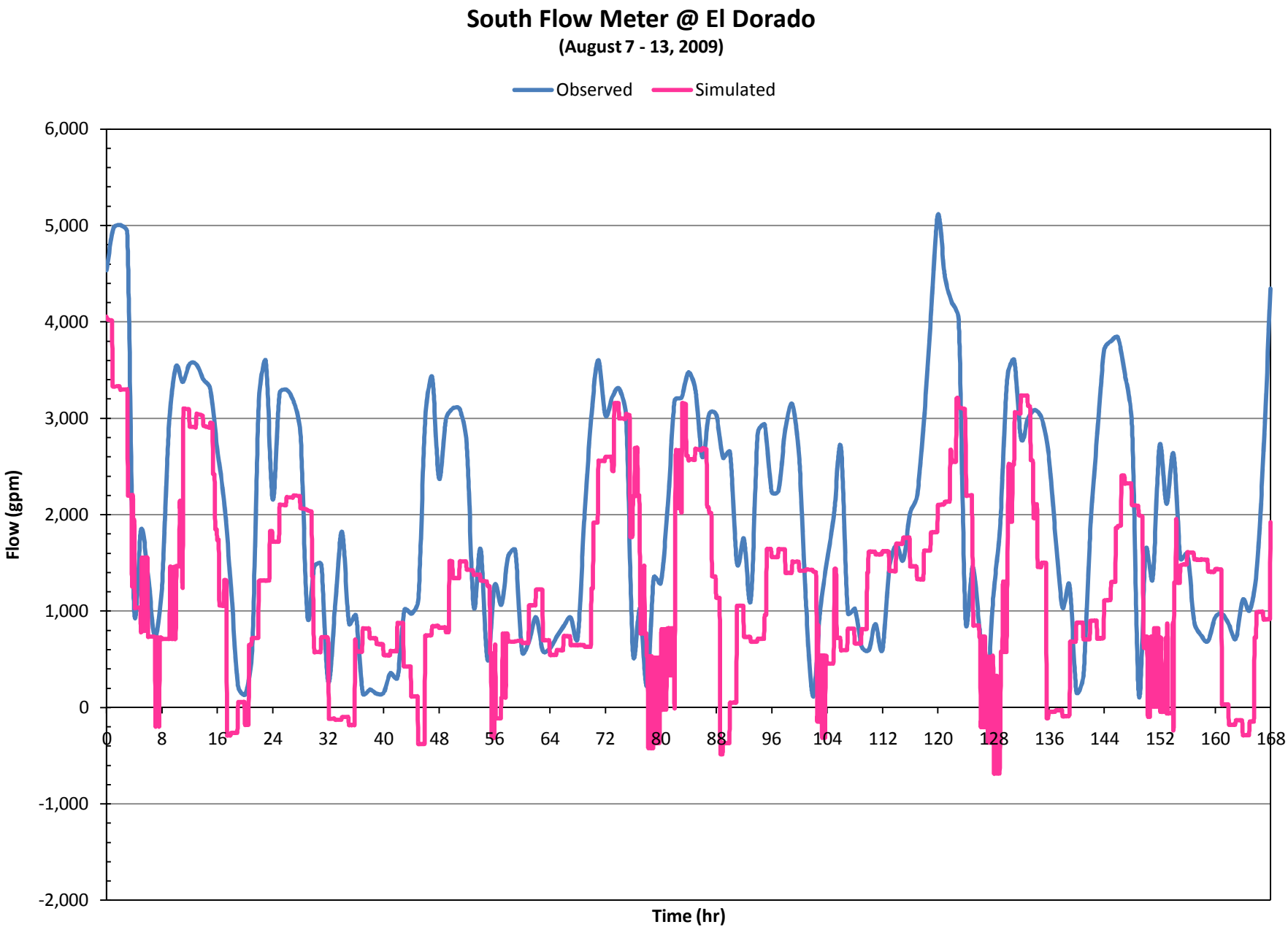
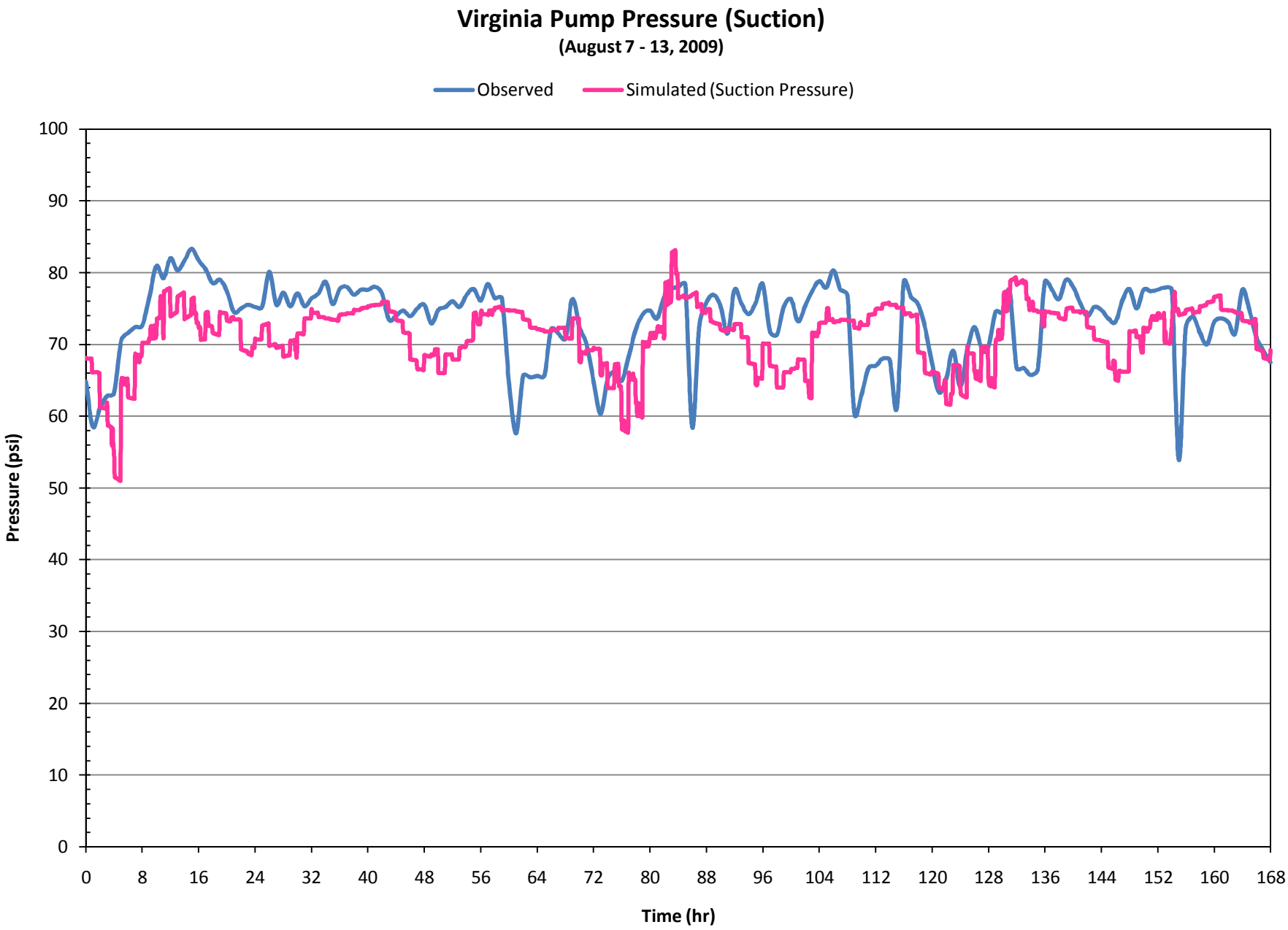

El Dorado Pumps
(August 7 - 13, 2009)
Observed
Simulated
Flow (gpm)
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
8
16
24
32
40
48
56
64
72
80
88
96
104
112
120
128
136
144
152
160
168
Time (hr)



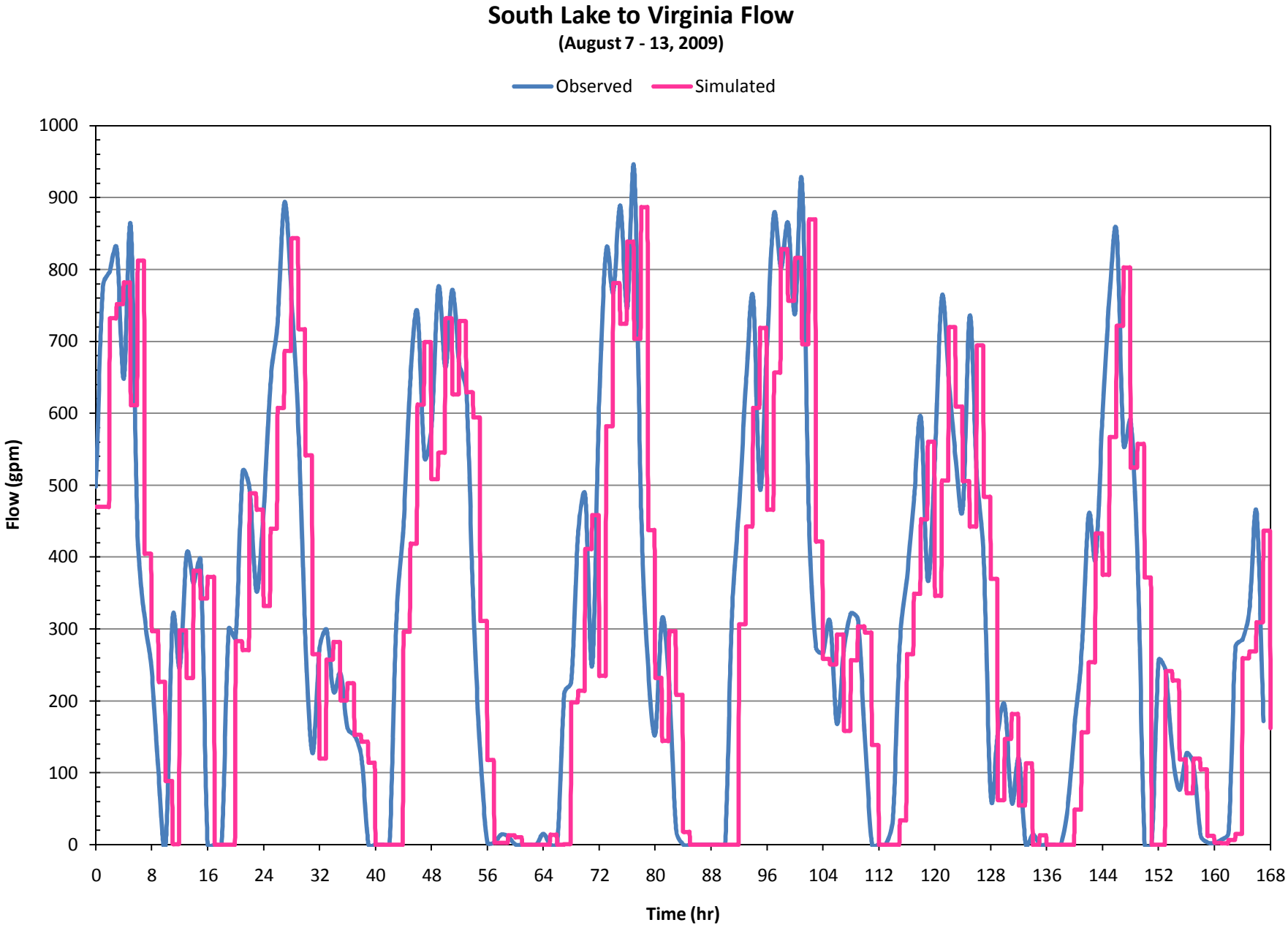
Model Comparisons_20100703.xlsx



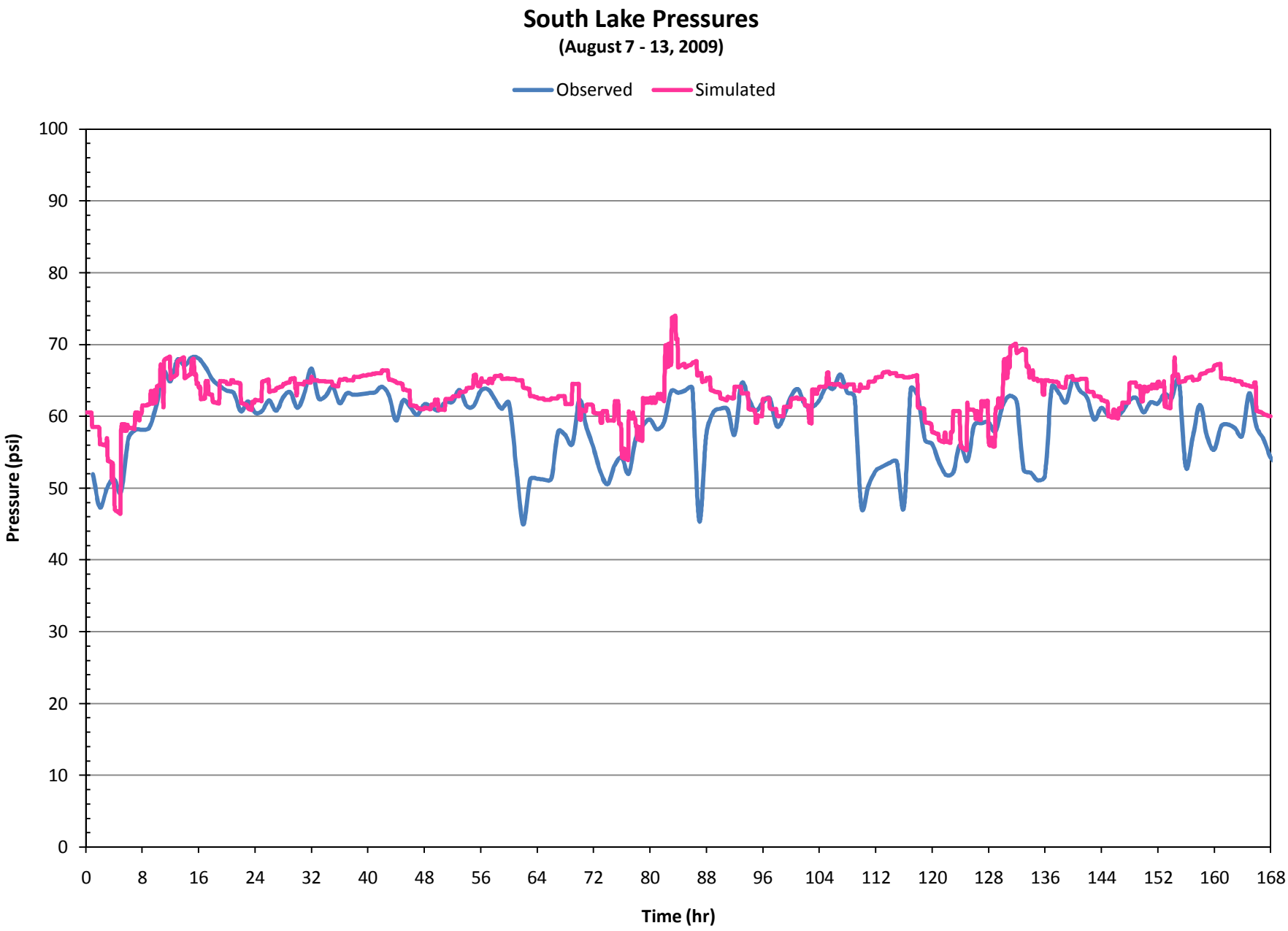
Model Comparisons_20100703.xlsx



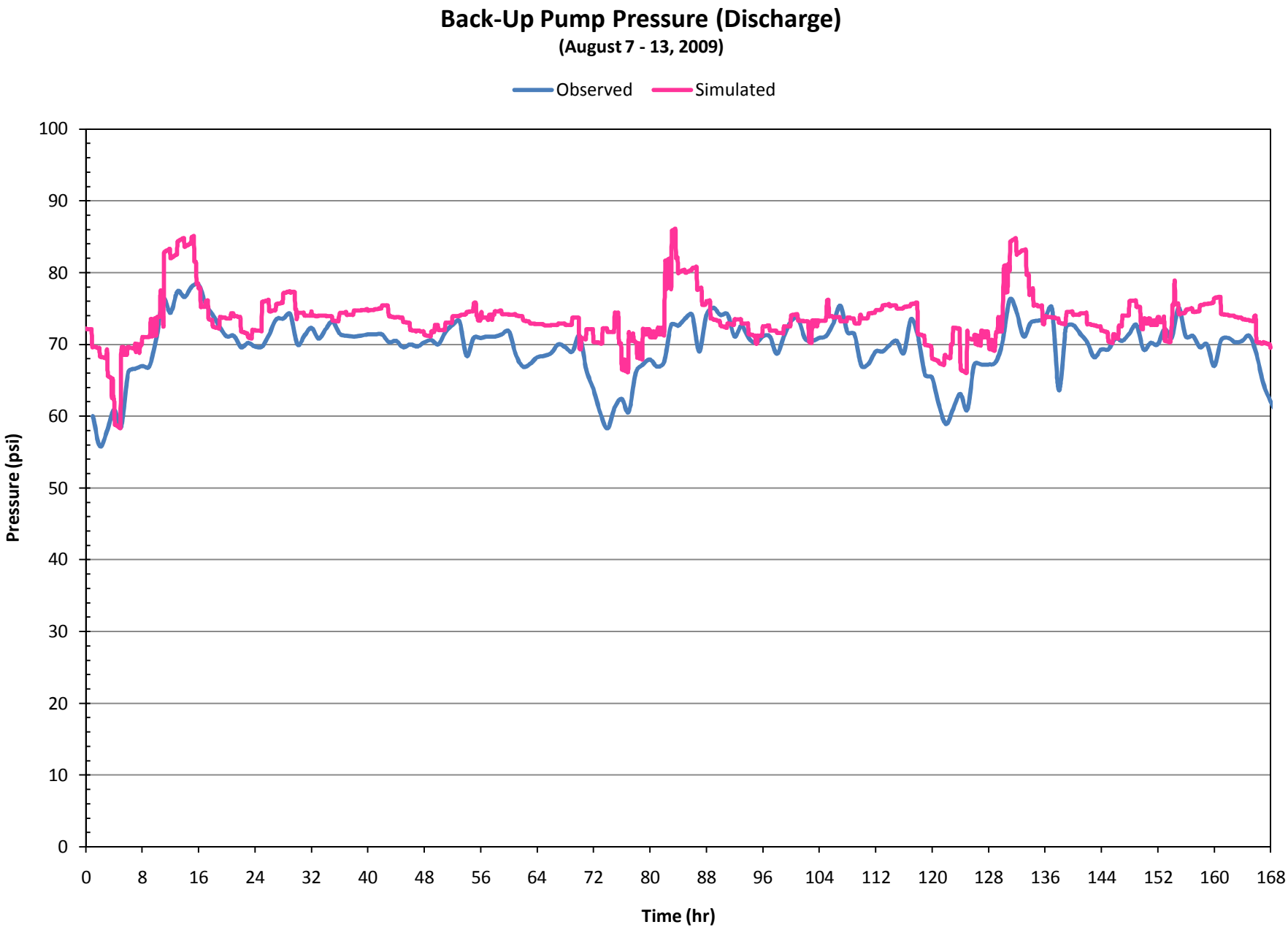
Model Comparisons_20100703.xlsx



Model Comparisons_20100703.xlsx



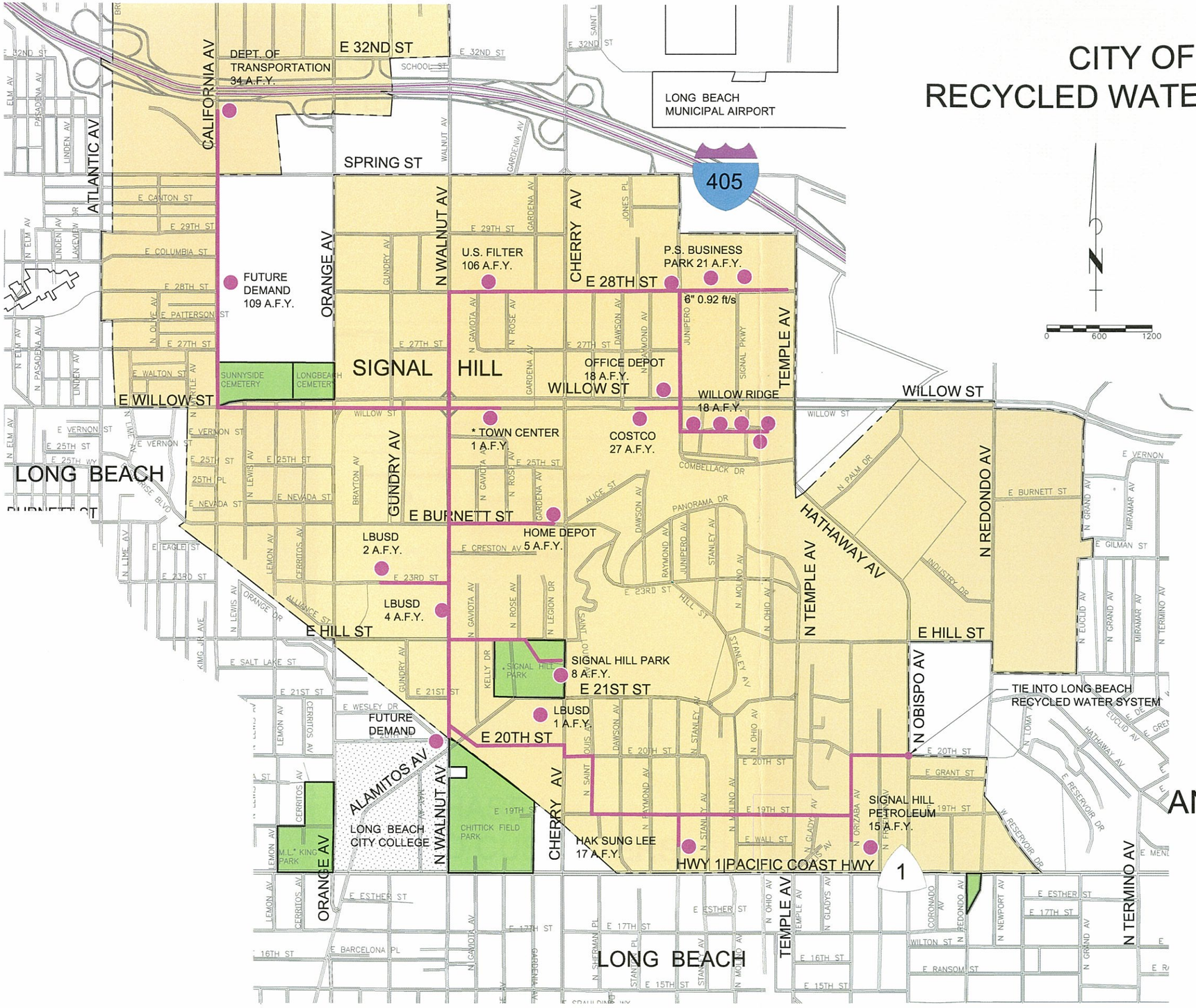
Model Comparisons_20100703.xlsx



Model Comparisons_20100703.xlsx

Appendix D
City of Signal Hill Potential Recycled Water Customers Figure

CITY OF SIGNAL HILL
RECYCLED WATER FEASIBILITY STUDY



LATERAL SITES	AFY
SIGNAL HILL PETROLEUM	15
HAK SUNG LEE	17
LBUSD	1
SIGNAL HILL PARK	8
LBUSD	4
LBUSD	2
HOME DEPOT	5
TOWN CENTER	1
COSTCO	27
WILLOW RIDGE	18
OFFICE DEPOT	18
P.S. BUSINESS PARK	21
U.S. FILTER	106
DEPT CALTRANS	33
FUTURE DEMAND	127
TOTAL	404

LEGEND

- CITY LIMITS
- RECYCLED WATER ALIGNMENT
- POTENTIAL USER LOCATION

ULTIMATE PROJECT AND CUSTOMER DEMANDS PROPOSED PIPELINE ALIGNMENT FIGURE 7-1

JUNE 2005

PLANS PREPARED BY:
TETRA TECH, INC.
3475 East Foothill Blvd., Suite 300
Pasadena, California 91107
(626) 351-4664
(626) 683-0060 FAX

N:\07109\0006\Cadd\REPORT_FIGS\OVERALL_MAP.dwg 06/15/2005 09:03

Appendix E
City of Lakewood Potential Recycled Water Customers Figure and Table

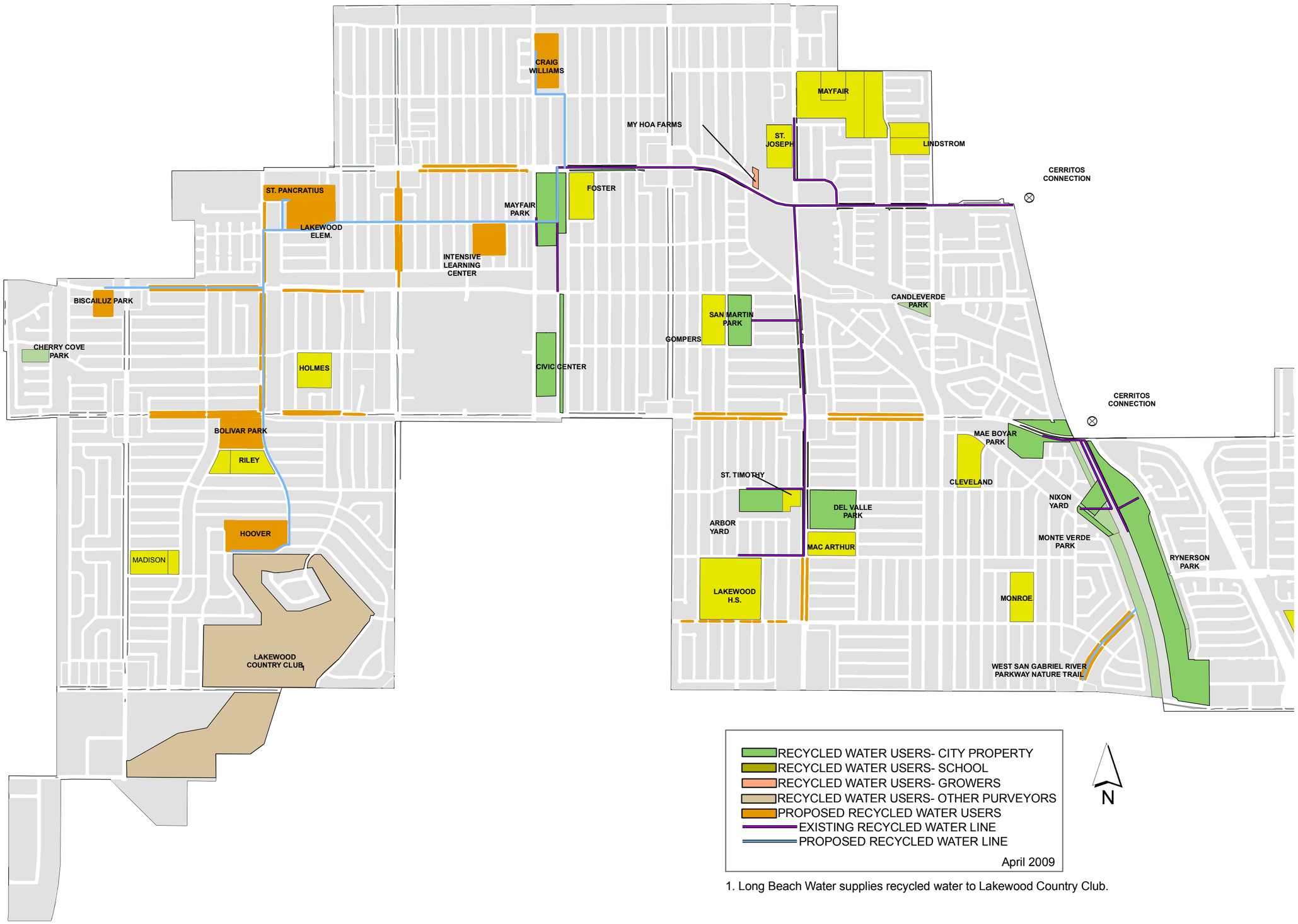
City of Lakewood
Potential Recycled Water Use

Service	Map #	Address	Accout No.	Meter No.	Meter Size	Annual Use	Est. Irrigation Use (HCF)	Est. Irrigation Use (AFY)	City Irrigation Use (HCF)		City Irrigation Use (AFY)		Additional Information
Facilities To Serve:													
Craig Williams Elementary		6144 Clark Ave.	5404800027	60131733	2"	3,562	3,562	8					Irrigation, meter by backflow device
			5404500031	V521772	2"	1,164							Domestic Water
Intensive Learning Center		4718 Michelson St.	6734100011	70076569	3"	7,737	5,803	13					
Lakewood Elementary		3717 Michelson St.	4719010030	60120759	4"	12,273	9,205	21					
St. Pancratius Church/School		3601 St. Pancratius Pl.	4721110010	16261118	2"	2,150							
		5737 Coke Ave.	6439900011	97072514	2"	2,887	2,887	7					Serves field
Bolivar Park		3300 Del Amo Blvd.	8926210011	70076565	3"	12,423			9,317	9,317	21	21	
Hoover Junior H.S.		3501 Country Club Dr.	0112511101	98818009	2"	5,158	5,158	12					Irrigation, meter by light pole, west end of school
			0112511003	98818018	2"	5,041	5,041	12					Irrigation, west meter
			0112508004	V523033	2"	312							Middle meter
			0112509005	U429160	2"	306							South meter
			0112510015	T362791	2"	300							North meter
Biscailuz Park		2601 Dollar St.	4616790013	700776574	3"	3,120			2,340	2,340	5	5	
Parkways To Serve:													
South St. West of Clark Ave.	13	4915 South St.	5810010017	96781776	2"	237			237		1		Irrigation North Side
	14	4705 South St.	5925010010	96509737	2"	235			235		1		North Side
	15	4505 South St.	5935010013	97295468	2"	233			233		1		Across From 4505 South St., Irrigation North Side
		0 South St.	6426410015	R118334	1-1/2"	314			314		1		South St. at Castana Ave. South Side
		000 Castana Ave.	6211510019	97072510	1-1/2"	355			355		1		Across from 5802 Castana Ave. North Side
	17	5745 Pennswood Ave.	6610910011	97295467	2"	390			390		1		Across From 5745 Pennswood Ave. on south St., Irrigation South Side
	16	5744 Blackthorne Ave.	6547210011	96781767	2"	284			284	2,048	1	5	Across From 5744 Blackthorne Ave. on South St., Irrigation South Side
Lakewood Blvd. North of Michelson St.	18	5634 Lakewood Blvd.	6555510011	R118361	1-1/2"	162			162		0		Across From 5634 Lakewood Blvd. East Side
	21	Lakewood Blvd. 335' North of Michelson St.	6418210010	R118356	1"	90			90	252	0	1	West Side
Lakewood Blvd. South of Michelson St.	19	5438 Lakewood Blvd.	6532810018	60131732	2"	212			212		0		East Side
	20	Lakewood Blvd. 460' South of Michelson St.	6416610016	R118344	1-1/2"	1,885			1,885	2,097	4	5	Across From 5443 Lakewood Blvd., Irrigation West Side
Candlewood St. East of Downey Ave.	5	0 Candlewood St. 475' From Minturn, North Side	9020710011	T340152	1-1/2"	451			451		1		Across From 3723 Candlewood St. North Side
	44	0 Candlewood St. at Hayter Ave.	3729010010	P014900	1-1/2"	386			386		1		Next to Speed Limit Sign
	22	0 Candlewood St. At Minturn Ave., South Side	9006310015	R118393	1-1/2"	430			430	1,267	1	3	East of Minuturn Ave. South Side
Candlewood St. West of Downey Ave.	35	Candlewood St. 550' West of Downey Ave.	9223210018	R118392	1-1/2"	259			259		1		North Side
	34	Candlewood St. 575' West of Obispo Ave, North Side	9225510015	P014845	1-1/2"	264			264		1		Across From 2853 Candlewood St. North Side
	36	Candlewood St. at Levelside Dr.	9231610017	R118359	1-1/2"	132			132		0		South Side
	37	0 Candlewood 560'	3347210010	R118388	1-1/2"	242			242	897	1	2	Across From 2852 Candlewood St. South Side
Downey Ave. North of Michelson St.	23	5630 Downey Ave.	4704710014	R118391	1-1/2"	274			274	274	1	1	East Side
Downey Ave. South of Michelson St.	24	5426 Downey Ave.	4723110018	R118375	1-1/2"	451			451	451	1	1	Across From 5424 Downey Ave.
Downey Ave. South of Candlewood St.	4	400' North of Del Amo Blvd.	9022610014	R118348	1-1/2"	193			193		0		Across From 4936 Downey Ave. East Side
	27	0 Downey Ave.280' South of Candlewood St.	9116710018	R118376	1-1/2"	273			273		1		In Front of 5157 Downey Ave. West Side
	25	0 downey Ave. 280' South of Candlewood St., East Side	9018010011	R118355	1-1/2"	347			347		1		Across From 5158 Downey Ave. East Side
	26	Downey Ave. 120' South of Hardwick St.	9023310019	R118379	1-1/2"	163			163	976	0	2	Across from 5036 Downey Ave. East Side
Del Amo Blvd. East of Downey Ave.	28	Del Amo Blvd. at Minturn Ave., North Side	9033610011	R118389	1-1/2"	1,484			1,484		3	-	North Side
	29	Del Amo Blvd. at Hayter Ave.	3725410014	R118347	1-1/2"	197			197		0	-	North Side
	2	Del Amo Blvd 103' West of Lakewood Blvd., South Side	8200010011	96510052	1-1/2"	1,239			1,239		3	-	South Side
	1	0 R/W Del Amo Blvd. at Downey Ave.	8904710012	47582866	1"	251			251	3,171	1	7	25' East of the Curb- Flood Control South Side
Del Amo Blvd. West of Downey Ave.	32	0 Del Amo Blvd. 535' West of Downey Ave., North Side	9101110013	R118387	1-1/2"	565			565		1		North Side
	33	0 Del Amo Blvd.	3201010010	R118360	1-1/2"	558			558		1		Across From 2903 Del Amo Blvd. North Side

City of Lakewood
Potential Recycled Water Use

Service	Map #	Address	Accout No.	Meter No.	Meter Size	Annual Use	Est. Irrigation Use (HCF)	Est. Irrigation Use (AFY)	City Irrigation Use (HCF)		City Irrigation Use (AFY)		Additional Information
	30	0 Del Amo Blvd. 545' West of Downey Ave.	8903710018	R118383	1-1/2"	618			618		1		Middle of Parkway Panel-Bolivar Park South Side
	31	Del Amo Blvd. 560' West of Obispo Ave., South Side	3423310011	R118394	1-1/2"	810			810	2,551	2	6	Across From 2902 Del Amo Blvd. South Side
Del Amo Blvd. East of Woodruff Ave.	8	Del Amo Blvd. 20' West of Canehil Ave., North Side	2927910012	P014916	1-1/2"	338			338				North Side
	7	Del Amo Blvd.	2929310003	R118367	1-1/2"	357			357				Across From 6037 Del Amo Blvd. North Side
	5	0 Del Amo Blvd.120' East of Snowden Ave., South Side	7520210010	96781764	2"	457			457				South Side
	6	0 Del Amo Blvd. 170' East of Faust Ave.	7630610019	R118369	1-1/2"	204			204	1,356	0	3	South Side
Del Amo Blvd. West of Woodruff Ave.	9	0 Del Amo Blvd. 600' West of Silva St.	8118410010	R120145	1-1/2"	688			688				North Side
	10	Del Amo Blvd. at Coldbrook Ave., North Side	8015110013	R118368	1-1/2"	428			428				North Side
	12	0 Del Amo Blvd. 80' West of Lomina Ave., South Side	7313510014	R118363	1-1/2"	596			596				South Side
	11	Del Amo Blvd. at Coldbrook Ave., South Side	7433610011	R118374	1-1/2"	692			692	2,404	2	6	South Side
Los Coyotes Diag.	2	Los Coyotes Diag. 425' North of Harvey Way, East Side	9455010013	96781085	1-1/2"	449			449		1		Across From 4236 Los Coyotes Diag. East Side
	1	Los Coyotes Diag. 100' South of Harvey Way, East Side	9439910010	97395329	1-1/2"	428			428		1		East Side
	3a	4273 Los Coyotes Diag.	9311810013	17554075	1-1/2"	133			133		0		Across From 4273 Los Coyotes Diag. In Parkway Panel West Side
	3	Los Coyotes Diag., 425' North of Harvey Way	9311110010	7113844	1-1/2"	565			565		1		Across From 4243 Los Coyotes Diag., Irrigation West Side
	4	0 999 4171 Los Coyotes Diag.	9438310018	29599836	1-1/2"	73			73	1,648	0	4	Across From 4171 Los Coyotes Diag. West Side
Woodruff Ave. South of Centralia St.	40	0 Woodruff Ave. 120' North of Gallup St., East Side	7708510013	R118381	1-1/2"	526			526		1		East Side
	39	Woodruff Ave. 620' South of Centralia St., West Side	2001210015	R118353	1-1/2"	499			499	1,025	1	2	Irrigation West Side
Harvey Way West of Woodruff Ave.	38	0 Harvey Way 240' East of Marber Ave.	1909910013	R124348	1-1/2"	121			121		0		South Side
	41	999 Harvey Way at Sebren Ave.	1914110010	R124337	1-1/2"	328			328		1		South Side
	42	0 Harvey Way at Ocana Ave.	1922710013	R124342	1-1/2"	228			228		1		South Side
	43	0 Harvey Way	2006610017	R124328	1-1/2"	158			158	835	0	2	South Side
					TOTAL (HCF)		31,656		32,909	32,909			
					TOTAL (AF)		73			76			

LAKEWOOD RECYCLED WATER SYSTEM
PROPOSED SYSTEM EXPANSION



1. Long Beach Water supplies recycled water to Lakewood Country Club.

Appendix F
Supply and Storage Analysis

Table F-1
Available flows to LVL on a weekly basis (mgd)
No Future LBWD Demands

Week	Available flows to LVL (mgd) No additional Storage	Available flows to LVL (mgd) 3.3 MG of Additional Storage	Available flows to LVL (mgd) 6.6 MG of Additional Storage
1	11.3	11.3	11.3
2	12.3	12.3	12.3
3	10.4	10.4	10.4
4	10.6	10.6	10.6
5	10.4	10.4	10.4
6	13.4	13.5	13.5
7	14.6	14.6	14.6
8	14.8	14.8	14.8
9	14.4	14.4	14.4
10	13.9	13.9	13.9
11	12.1	12.1	12.1
12	10.2	10.3	10.3
13	9.0	9.1	9.3
14	8.2	8.8	9.3
15	8.2	8.3	8.4
16	7.0	10.5	11.3
17	8.9	8.9	8.9
18	8.7	8.7	8.7
19	10.2	10.2	10.2
20	9.2	9.4	9.4
21	8.7	9.4	9.4
22	9.1	9.9	10.0
23	9.7	10.2	10.2
24	9.3	9.3	9.3
25	8.4	8.4	8.4
26	8.4	9.3	9.7
27	10.2	10.7	10.7
28	7.1	8.0	8.3
29	6.2	6.5	6.5
30	5.5	5.5	5.5
31	5.9	6.6	7.1
32	9.0	9.6	9.6
33	9.2	9.7	9.7
34	10.1	10.2	10.2
35	9.5	10.0	10.0
36	9.9	10.4	10.4
37	7.8	7.8	7.8
38	7.6	7.7	7.7
39	7.2	7.7	7.7
40	8.4	8.5	8.5
41	10.3	10.9	11.0
42	12.1	12.8	13.1
43	13.2	13.2	13.2
44	12.1	12.1	12.1
45	11.6	11.9	11.9
46	12.7	12.7	12.7
47	12.8	12.8	12.8
48	12.0	12.0	12.0
49	12.0	12.3	12.3
50	13.6	13.6	13.6
51	14.2	14.2	14.2
52	14.5	14.5	14.5
53	14.1	14.1	14.1

Table F-2
Available flows to LVL on a weekly basis (mgd)
Most Probable LBWD Demands

Week	Available flows to LVL (mgd) No additional Storage	Available flows to LVL (mgd) 3.3 MG of Additional Storage	Available flows to LVL (mgd) 6.6 MG of Additional Storage
1	8.5	8.5	8.5
2	10.2	10.2	10.2
3	6.6	7.8	7.8
4	8.3	8.3	8.3
5	8.2	8.2	8.2
6	8.7	9.3	9.8
7	12.6	12.6	12.6
8	12.9	12.9	12.9
9	12.2	12.2	12.2
10	11.9	11.9	11.9
11	10.8	10.8	10.8
12	7.5	7.7	7.7
13	6.4	6.4	6.6
14	5.4	6.1	6.6
15	4.6	5.1	5.5
16	5.2	6.5	8.7
17	6.5	6.9	6.9
18	6.2	6.3	6.3
19	7.4	7.7	7.7
20	6.5	7.0	7.0
21	5.4	6.0	6.6
22	6.8	7.6	7.6
23	7.4	7.9	7.9
24	6.9	6.9	6.9
25	5.7	5.7	5.7
26	5.4	6.6	7.3
27	8.2	8.7	8.7
28	3.8	4.9	5.7
29	3.7	4.3	4.3
30	3.1	3.1	3.1
31	3.5	4.2	4.6
32	5.6	6.9	6.9
33	6.9	7.5	7.6
34	7.7	7.9	7.9
35	7.0	7.4	7.6
36	7.9	8.4	8.4
37	5.6	5.6	5.6
38	5.2	5.2	5.2
39	4.8	5.2	5.2
40	5.6	5.7	5.7
41	7.2	7.8	8.3
42	9.4	10.6	10.8
43	10.8	11.1	11.1
44	9.6	9.6	9.6
45	9.1	9.7	9.7
46	10.5	10.7	10.7
47	10.4	10.4	10.5
48	8.3	9.0	9.0
49	8.8	9.2	9.5
50	10.7	10.7	10.7
51	12.1	12.1	12.1
52	12.7	12.7	12.7
53	11.9	11.9	11.9

Table F-3
Available flows to LVL on a weekly basis (mgd)
All LBWD Future Demands

Week	Available flows to LVL (mgd) No additional Storage	Available flows to LVL (mgd) 3.3 MG of Additional Storage	Available flows to LVL (mgd) 6.6 MG of Additional Storage
1	7.0	7.0	7.5
2	8.8	8.8	9.3
3	5.2	5.9	6.4
4	6.4	6.4	6.9
5	5.9	5.9	6.5
6	4.0	5.1	6.5
7	11.2	11.2	11.7
8	11.8	11.8	12.3
9	10.4	10.4	10.9
10	10.7	10.7	11.2
11	9.5	9.5	10.0
12	5.1	5.7	6.2
13	3.6	3.7	4.4
14	2.6	3.2	4.3
15	2.9	3.2	4.1
16	2.3	5.0	7.3
17	4.3	4.7	5.2
18	4.2	4.4	4.9
19	5.8	6.0	6.5
20	4.3	5.1	5.6
21	3.0	4.0	5.3
22	4.6	5.6	6.3
23	5.5	6.2	6.7
24	5.0	5.0	5.5
25	3.7	3.8	4.3
26	3.1	4.4	5.7
27	6.6	7.1	7.6
28	2.0	3.1	4.7
29	1.1	2.5	3.0
30	0.7	1.1	1.6
31	0.9	2.1	3.2
32	3.2	5.0	5.7
33	4.8	5.4	6.2
34	5.1	6.1	6.7
35	4.2	5.5	6.3
36	5.9	6.6	7.2
37	3.6	3.7	4.2
38	3.4	3.4	3.9
39	2.7	3.3	3.8
40	1.1	3.8	4.3
41	3.9	5.2	6.2
42	5.7	8.3	9.5
43	9.6	9.6	10.1
44	6.4	8.0	8.5
45	7.0	7.1	8.1
46	7.9	8.9	9.4
47	8.9	8.9	9.4
48	6.6	7.3	8.0
49	3.0	5.9	6.8
50	7.3	8.5	9.2
51	10.7	10.7	11.2
52	11.4	11.4	11.9
53	10.1	10.1	10.6

Table F-4
Storage Requirements
Most Probable Customers
(El Dorado PS = 15,000 gpm)

Scenario	LBWD Existing Demands (mgd)	LBWD Future Demands (mgd)	WRD Demand (mgd)	Demand through El Dorado PS (mgd)	LBWRP Filter Effluent Flow (mgd)	Source of WRD Supply	Supply Needs Met (Yes/No)	Storage Required* (MG)
Existing	4.79	-	4.32	9.11	15.75	LBWD	Yes	2.71
Existing + Most Probable	4.79	2.24	4.32	11.34	15.75	LBWD	Yes	3.97
Existing + Most Probable + WRD expansion	4.79	2.24	8.64	15.66	15.75	LBWD	Yes	10.35

Notes:
All values are average values for August 2009
mgd = million gallons per day
MG = million gallons

Demands for the most probable customers located on alternative pipelines in LBWD's service area (excluding the WRD expansion and neighboring cities) is approximately 2.2 mgd

Analysis assumes that El Dorado Pump Station capacity is 15,000 gpm (existing pump station capacity with six pumps running)
Additional pumps will provide limited additional flow from the pump station

* This value is operational storage and is not total storage, recognizing that tanks cannot be drained completely.
Under existing demands, only the top one-third of the Alamitos Reservoir can be used for operational storage without leading to low recycled water system pressures

Table F-5
Storage Requirements
All Customers
(El Dorado PS = 15,000 gpm)

Scenario	LBWD Existing Demands (mgd)	LBWD Future Demands (mgd)	WRD Demand (mgd)	Demand through El Dorado PS (mgd)	LBWRP Filter Effluent Flow (mgd)	Source of WRD Supply	Supply Needs Met (Yes/No)	Storage Required* (MG)
Existing + All	4.79	4.02	4.32	13.13	15.75	LBWD	Yes	7.16
Existing + All + WRD**	4.79	4.02	6.95	15.75	15.75	LBWD	No	11.78

Notes:
All values are average values for August 2009
mgd = million gallons per day
MG = million gallons

Future demands located on alternative pipelines in LBWD's service area (excluding the WRD expansion and neighboring cities) is approximately 4.0 mgd

Analysis assumes that El Dorado Pump Station capacity is 15,000 gpm (existing pump station capacity with six pumps running)
Additional pumps will provide limited additional flow from the pump station

* This value is operational storage and is not total storage, recognizing that tanks cannot be drained completely.
Under existing demands, only the top one-third of the Alamitos Reservoir can be used for operational storage without leading to low recycled water system pressures

** WRD demand is reduced so that total demand does not exceed total supply

Table F-6
Storage Requirements
Most Probable Customers
(El Dorado PS = 18,200 gpm)

Scenario	LBWD Existing Demands (mgd)	LBWD Future Demands (mgd)	WRD Demand (mgd)	Demand through El Dorado PS (mgd)	LBWRP Filter Effluent Flow (mgd)	Source of WRD Supply	Supply Needs Met (Yes/No)	Storage Required* (MG)
Existing	4.79	-	4.32	9.11	16.22	LBWD	Yes	2.71
Existing + Most Probable	4.79	2.24	4.32	11.34	16.22	LBWD	Yes	3.97
Existing + Most Probable + WRD expansion	4.79	2.24	8.64	15.66	16.22	LBWD	Yes	8.43

Notes:
All values are average values for August 2009
mgd = million gallons per day
MG = million gallons

Demands for most probable customers located on alternative pipelines in LBWD's service area (excluding the WRD expansion and neighboring cities) is approximately 2.2 mgd

Analysis assumes that El Dorado Pump Station capacity is 18,200 gpm (existing pump station capacity with 8 pumps running)
Additional pumps will provide limited additional flow from the pump station

* This value is operational storage and is not total storage, recognizing that tanks cannot be drained completely.
Under existing demands, only the top one-third of the Alamitos Reservoir can be used for operational storage without leading to low recycled water system pressures

Table F-7
Storage Requirements
All Customers
(El Dorado PS = 18,200 gpm)

Scenario	LBWD Existing Demands (mgd)	LBWD Future Demands (mgd)	WRD Demand (mgd)	Demand through El Dorado PS (mgd)	LBWRP Filter Effluent Flow (mgd)	Source of WRD Supply	Supply Needs Met (Yes/No)	Storage Required* (MG)
Existing + All	4.79	4.02	4.32	13.13	16.22	LBWD	Yes	7.02
Existing + All + WRD**	4.79	4.02	7.42	16.22	16.22	LBWD	No	12.24

Notes:
All values are average values for August 2009
mgd = million gallons per day
MG = million gallons

Future demands located on alternative pipelines in LBWD's service area (excluding the WRD expansion and neighboring cities) is approximately 4.0 mgd

Analysis assumes that El Dorado Pump Station capacity is 18,200 gpm (existing pump station capacity with 8 pumps running)
Additional pumps will provide limited additional flow from the pump station

* This value is operational storage and is not total storage, recognizing that tanks cannot be drained completely.
Under existing demands, only the top one-third of the Alamitos Reservoir can be used for operational storage without leading to low recycled water system pressures

** WRD demand is reduced so that total demand does not exceed total supply